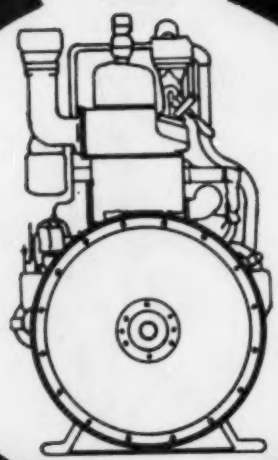
diesel power

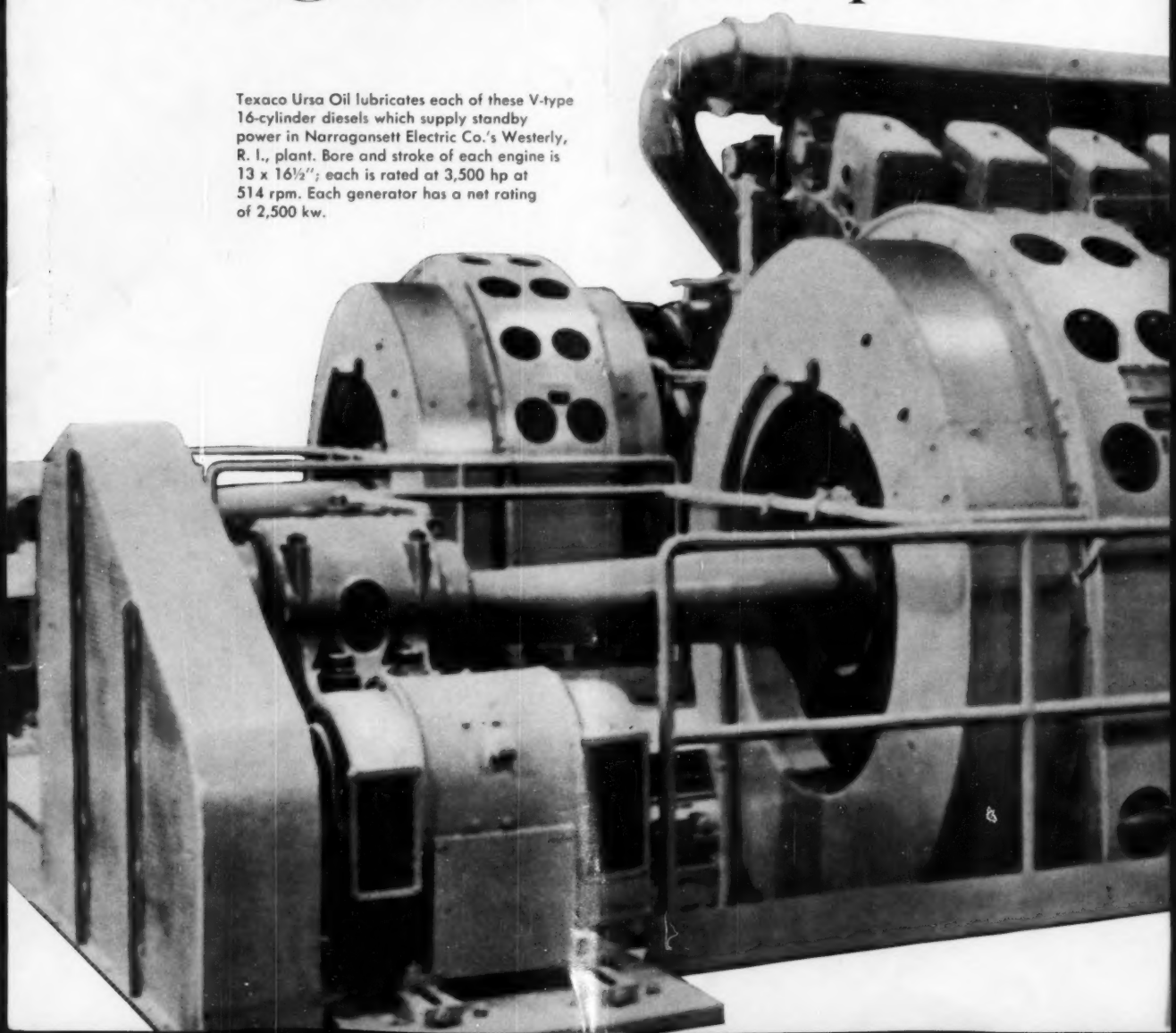
August 1958



Texaco URSA OIL protects

Narragansett's reserve power

Texaco Ursa Oil lubricates each of these V-type 16-cylinder diesels which supply standby power in Narragansett Electric Co.'s Westerly, R. I., plant. Bore and stroke of each engine is 13 x 16½"; each is rated at 3,500 hp at 514 rpm. Each generator has a net rating of 2,500 kw.



Narragansett Electric Company uses these two Supairthermal V-16 diesels for standby power. It's essential that these engines be instantly available, even after long periods of idleness. That's why Narragansett uses Texaco Ursa Oil to protect engine power, keep it reliable and ready—anytime.

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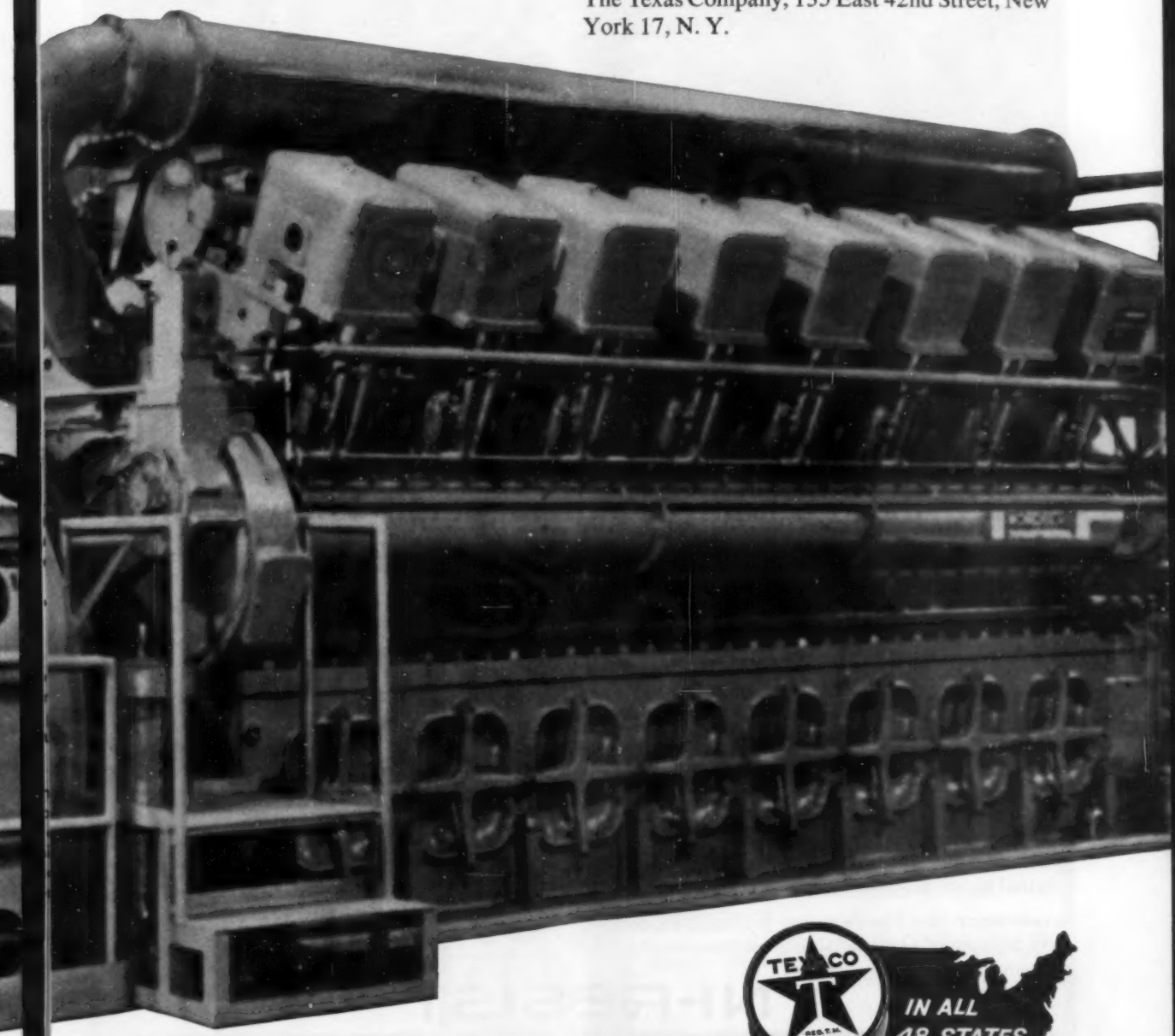

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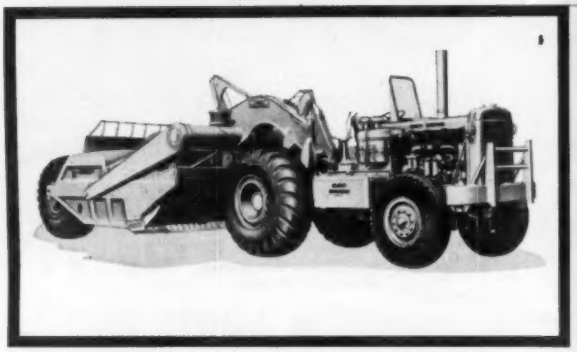

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AiResearch Industrial Division

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BPA

diesel power

Established in 1923 **Vol. 36, No. 8** **August, 1958**

The Magazine of Piston and Turbine Power

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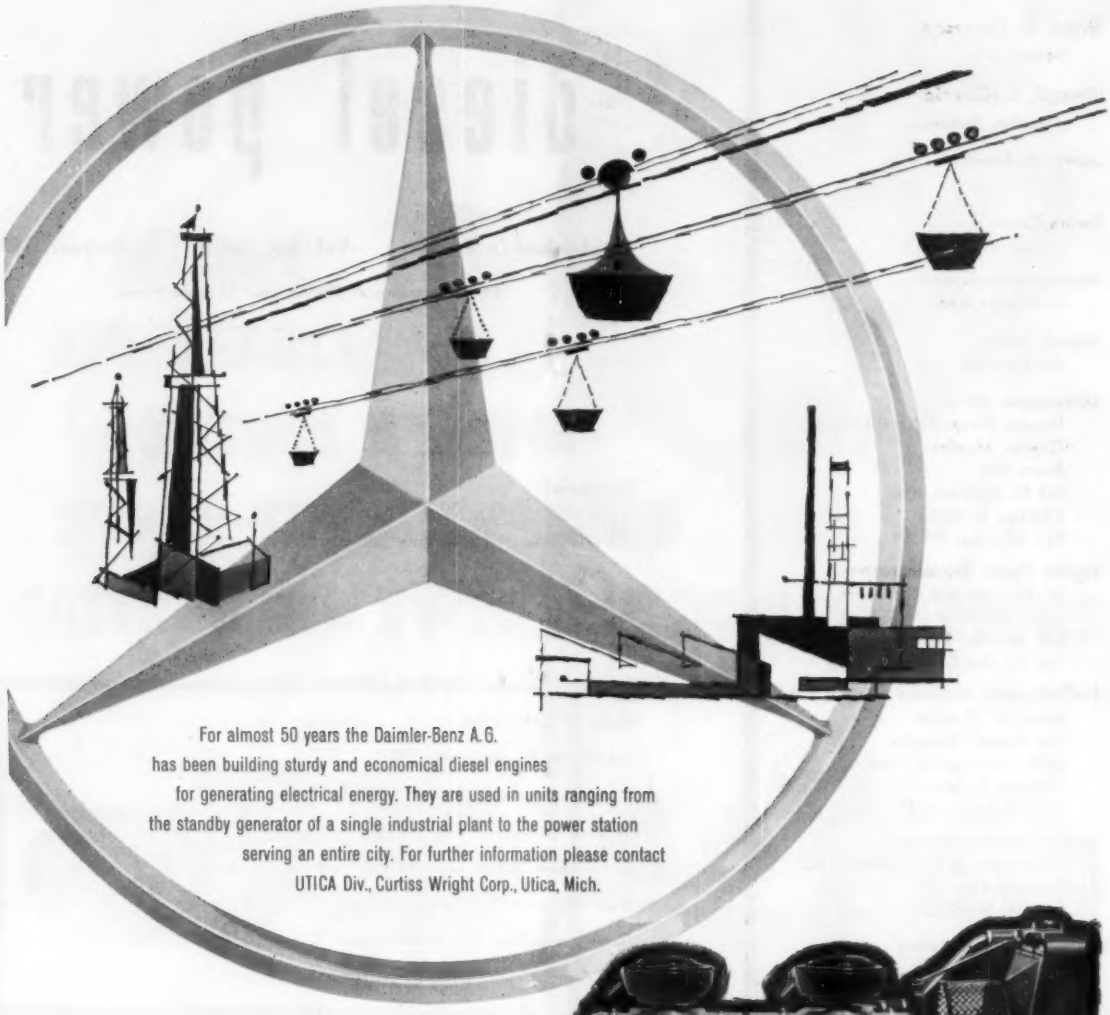

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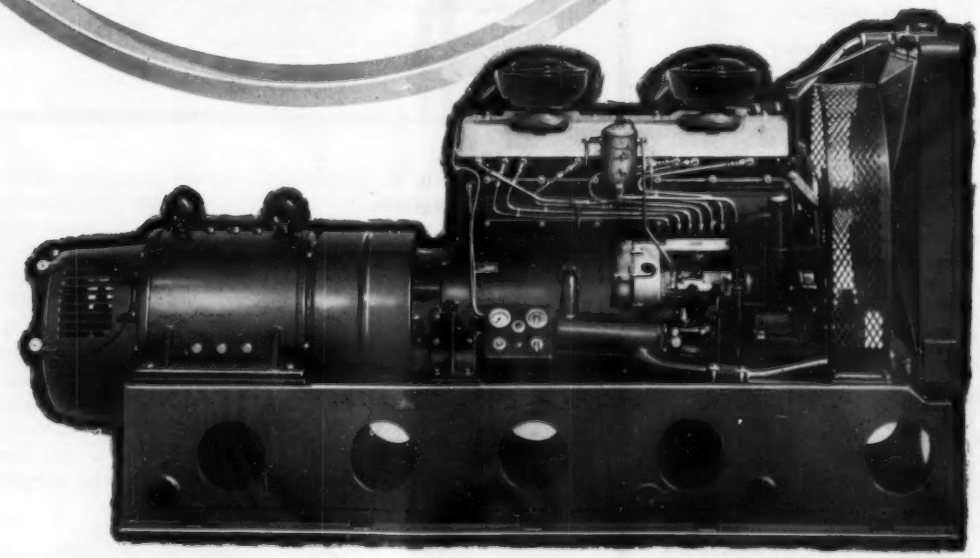

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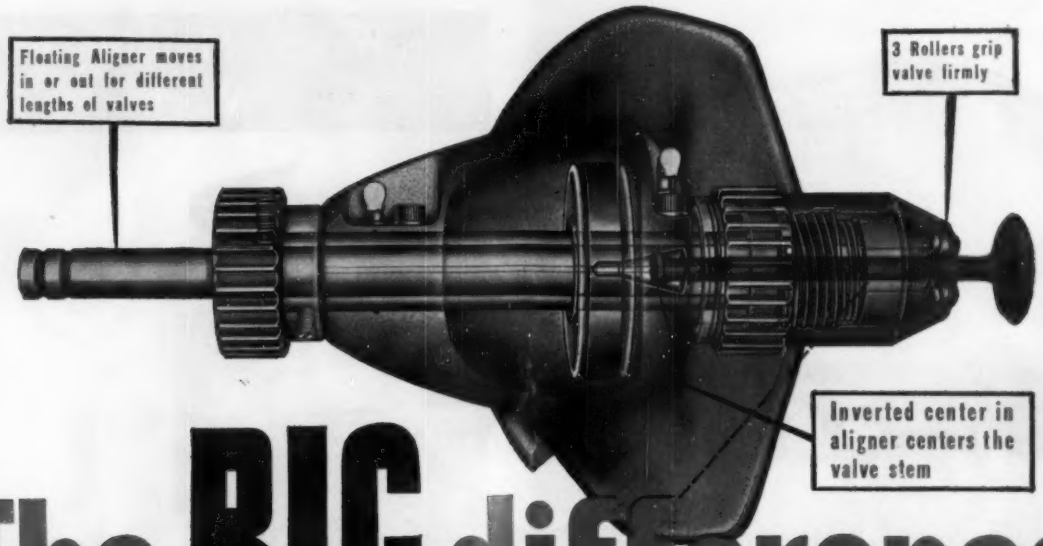
Floating Aligner moves in or out for different lengths of valves
3 Rollers grip valve firmly
Inverted center in aligner centers the valve stem

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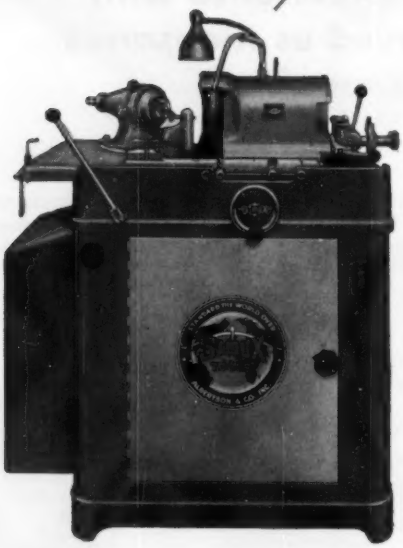
is in the SIOUX QUICK-ACTING ROLLER CHUCK!



IF you had to choose one feature making the largest contribution to the speed and accuracy of the SIOUX Valve Face Grinding Machine it probably would be the quick-acting, easily cleaned, roller chuck. The inverted center floating aligner holds the valve accurately in the position in which it operates in the engine while valves are ground to within .001". It's fast, easy and accurate.

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Editorially speaking -

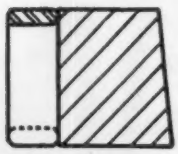
". . . everything we know."

"We spare ourselves a lot of trouble by telling people everything we know . . . before they hear it from somebody else." We'd like to add the following thought, ". . . . and probably wrong", to these words from International Harvester's retiring Board Chairman, J. L. McCaffrey. We're sure he would accept the revision. His words apply to everything from telling your young daughter about the birds and bees to the subject of engine information. We have talked up Mr. McCaffrey's viewpoint for years. The main function of a trade publication is to pass on constructive ideas. It must tell its readers things they need to know. Through many contacts and surveys, we found that the greatest need—hence the area in which we could do the most good—was for technical information. Readers want data in depth on design, operation, application and maintenance. Supplying this became and still is our editorial objective. The hardest data to get was in the important area of maintenance. Ten years ago, there was little such information available for publication. With few exceptions, engine builders took the attitude, "Our dealers and distributors have all the necessary data; tell your readers to take their engines to them." Sound advice but it overlooks certain factors. When someone buys an engine, it is his. If he expects warranty privileges, he has certain responsibilities. Otherwise, he has the right to fix his own engine, take it where he wants for repair, or just neglect it. He owns it, it's his choice and he pays the bills. He might make it tough on the product's good name but these are the facts of life. In exercising his options, technical data was often coming "from somebody else" and was often wrong. This is rapidly being corrected as builders serve their users and protect their products by tending to the idea of "telling people everything we know." We're glad to see and have part in implementing this trend. Let's keep it up for a more enlightened and better industry.

BPE

PEDRICK pioneered Conformable rings for big-bore engines

U.S. Patent No. 2,771,329



TF7 DESIGN

This design is recommended especially for 4-cycle engines

Here's Pedrick's Conformable TAPER-FACE COMPRESSION Ring

The big feature of the TF7 taper-face compression ring is its conformability under all kinds of cylinder conditions. Because of PEDRICK'S exclusive "Equalizer," which exerts a positive and uniform pressure outward at every point around the ring circumference, the cast-iron section is radially thinner, and therefore more flexible.

The taper-face of this conformable compression ring provides a line contact with the cylinder wall for higher unit pressure, quicker seating and sealing and less chance of scuffing.

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Pedrick® PISTON RINGS

highlights

Look for a boom in oil exploration and drilling when Alaska Statehood gets all straightened out. There's oil there and as soon as legal aspects of land availability are clarified, many companies will be moving in.

Engineers trying to read Russian technical magazines have received an assist. A paper containing a concise vocabulary of Russian technical terms and useful expressions, together with an explanation of, and pronunciation guide for, the Russian alphabet, will be presented at the ASME Heat Transfer Conference in August.

Delco-Remy's research and forward engineering outlook has been broadened. An Applied Science Dept. and an Electro-Chemical Research Dept. have been formed. Their immediate objectives are to accumulate 'know-how' in newly-developed areas of science, and to keep abreast of scientific trends and changes in technology. Their eventual goal is to translate these advanced ideas into new and improved products for the Division.

Contractor-suggested improvements in earthmoving equipment include: (1) better air filtration system for high air flows of new, high-output engines; (2) heavier-duty electric system for more night work; (3) fully sealed bearings in sleave assemblies; (4) better plumbing for transfer of air or hydraulics; and (5) better cable and hydraulic systems. Points were raised at 1958 Earthmoving Conference, Central Illinois Section, SAE. Manufacturers please take note.

Diesel truck production was down somewhat in 1957 from 1956 figures. Automobile manufacturers Association reports factory sales of 24,455 and 25,797 units respectively. 1957 exports were up in the 19,500 GVW category and down in the larger sizes—For 1956, 276 units 19,500 GVW and under, 376 units in 1957. Large models exported were 2948 in 1956, 2305 in 1957. Registrations for 1956, totaled 103,469 (including LPG models). Diesel bus registrations for 1956 totaled 32,209 units. Registration figures are from U. S. Bureau of Public Roads with some data estimated by AMA.

Purchase of 340 new diesel buses and building of an East Side Manhattan bus repair shop are contemplated by the N.Y.C. Transit Authority. The buses will replace the last 175 trolley coaches in use and 10-11-year old vehicles.

AiResearch's first overseas shipment of turbochargers went to England for use on British-made diesels. This marked a new milestone in the expanding activities of The Garrett Corp. AiResearch Industrial Div.

Allis-Chalmer's Springfield, Ill. Works has called about 700 employees back to work. Increase in jobs resulted from reduction in stock of parts and completed construction machinery. Much of present production is being shipped directly from the production line to the customer.

Turbocharging has boosted the Deltic 18 2-cycle diesel output 24% to 3100 hp. This D. Napier & Son Ltd. turbocharged engine is not to be confused with the 5500-hp compounded Deltic whose output from three crankshafts is increased by power from a turbo-compressor set arranged within the delta and "geared-back" into the final drive.

Farm equipment industry looks good, according to W. H. Hewitt, Deere & Co. Department of Agriculture expects 1958 cash receipts from farm marketing to top 1957 by 4% to 5%. Current prices received are up 9%, prices paid up 3%. Farm consolidations continue to reduce costs and get more effective use of machinery. And as hours per year pile up and size requirements go higher, the case for diesels becomes stronger and stronger.

Cross-graded lube oils with more, and more potent additives are ahead for the diesel field, according to Socony-Mobil engineers. In an SAE Metropolitan Section paper they report that SAE 10W-30 oil compared favorably in severe engine tests with Mill-L-2104A SAE 30 oil. Cleanliness and wear were about the same, fuel consumption lower. Cross-graded oils help cold-weather starting and reduce brands and grades to be stocked in mixed fleets.

Selecting Fuel For High-Speed Diesels

A guide for the selection of the most economic commercially available fuel for your particular operating conditions.

Fuel selected for this GM diesel powered bus in city transit service should be one suitable for an engine operating with a wide variation in load and speed and much idling.

WHAT fuel are you using in your high-speed diesel? What fuels are available? What is your basis for selection? Maybe the fuel you're using is too good—or not good enough—for your particular type of service. Using too good a fuel imposes a price penalty. On the other hand, too poor a fuel imposes a maintenance cost and poor performance penalty.

There are *three fuels* commercially available for use in high-speed diesels—1D, 2D and No. 2. Selection of the proper and most economic fuel will depend principally on *three engine operating factors*—average loads, average rpm and ambient conditions. To meet these operating requirements, *three fuel qualities*—distillation range, cetane number and sulfur content are most important and must be considered in selecting a suitable fuel.

This series of three fuels, three operating factors and three fuel qualities will be related as a guide for selection.

What Fuels Are Available?

Three commercial grades of distillate fuel are commonly available for high-speed diesel use. These are the No. 1D and 2D fuels and No. 2 furnace oil. The latter is sometimes used and meets the minimum fuel specification requirements of at least one engine builder. In specific qualities and in price, these fuels scale down respectively.

The American Society of Testing Materials has set up specifications for each of these fuels. (See Table 1) Grade 1D fuels range from kerosene to intermediate distillates. Grade 2D has slightly inferior qualities and may contain a higher percentage of impurities.

No. 2 furnace oil is suitable for use under certain operating conditions and is recommended by some large builders of high-speed diesels. Its qualities are similar to those of 2D fuel. However, its cetane number is not listed and may be lower, its corrosive quality and ash content are not indicated, and its pour point is higher. These qualities, or lack of them, make this fuel less expensive than the 2D.

Engine Operating Factors

Average engine load, average rpm and ambient conditions are the operating factors having greatest influence on whether a fuel can be used satisfactorily. They determine which fuel will give trouble-free operation with minimum downtime and maintenance costs. The fuel you want is the least expensive one that will do this.

Temperatures within the cylinder and of its parts vary with speed, load and ambient temperature conditions. Even though cooling water temperatures may be normal, low engine speed and light loads keep the combustion chamber and surrounding parts at temperatures lower than when the engine runs at high speeds and high loads. Less fuel is burned under low-speed, low-load conditions, hence the lower temperatures.

Temperature of intake air also affects cylinder temperatures. For example, the temperature at the end of compression will be lower with 40°F intake air than with 90°F air. Lower cylinder temperatures will delay ignition of fuel and cause incomplete combustion if a fuel suitable for these conditions is not used. With the engine operating indoors or with a high ambient temperature and/or at continuous full speed and high load, cylinder temperatures will be higher and the engine will have greater tolerance with respect to certain fuel qualities. Thus, engine operating factors should be correlated to the fuel qualities in selecting the right fuel.

Operating Conditions Vs Fuel Qualities

Distillation range, one fuel quality that must be considered, is a measure of the fuel's volatility. For example, figures given for 90% distillation point show the temperature at which 90% of the fuel is vaporized. End point indicates the temperature at which all the fuel is vaporized. If engine service conditions are such that cylinder temperatures are low, a fuel with a low distillation range (vaporizing at lower temperatures) would give more satisfactory performance. If fuel does not completely vaporize at the low cylinder temperature, combustion may be incomplete and sludges and other harmful deposits will form in the engine. When cylinder temperatures run high, less expensive fuels with higher distillation ranges can be used.

Cetane number is an indication of the fuel's ignition quality. Fuels with lower cetane numbers take longer to ignite. During engine warm-up and light-load operation, especially in cold weather, this ignition lag may cause engine knocks and white puffs of unburned fuel in the exhaust. Harmful deposits may also accumulate if these conditions continue. Engine starting is also generally more difficult in cold weather with a low-cetane fuel.

TABLE I

ASTM Fuel Classification

Grade of Fuel Oil	Cetane Number (Min.)	Sulfur % by wt. (Max.)	Distillation Temperatures, °F	
			90% Boiling Point (Max.)	100% boiling Point (Max.)
No. 1-D	40	0.50	.....	625
No. 2-D	40	1.0	675	.....
No. 2	.....	1.0	675	.....

Cetane rating is of little importance in fuels used in engines working indoors or in warm weather and in continuous medium- and heavy-load operation.

Sulfur content gives an indication of the deposit formation and engine wear to be expected from corrosive products formed during combustion. Liners, pistons, rings, exhaust valves, etc., may all wear rapidly and excessive deposits form when using fuels of high sulfur content. Therefore, all other qualities being equal, pick a fuel with a low sulfur content if possible.

Inexpensive fuels with higher sulfur content can be used providing maintenance bills do not offset the saving in fuel cost. High cylinder temperatures, high loads and high ambient temperatures will give somewhat better tolerance for these higher sulfur fuels. When there is no choice and higher sulfur fuels must be used, special lube oils should be used to counteract the corrosive products of combustion.

For example, for all engines made by one large manufacturer, the Detroit Diesel Engine Div., heavy-duty lube oils of the Supplement 1 (S-1) type are recommended. If fuels with less than 0.5% sulfur content are used, Mil-L-2104A-type lube oils may be satisfactorily used. When fuels with a sulfur content approaching 1.0% are used, S-3 lube oils will give better performance. S-3 oils contain greater amounts of additives than S-2 or S-1 oils. A list containing the brand names of these oils which are commercially available, may be obtained from the Internal Combustion Engine Institute.

Special Fuel Quality Requirements

Under certain conditions, fuel qualities other than the three just discussed may be important. These are also specified in ASTM classifications. For example, in very cold weather when there is no provision for heating the fuel, its pour point, cloud point and viscosity should be considered.

Pour point tells the lowest temperature at which a particular fuel will flow. Pick one with a pour point 10°F below the lowest expected ambient temperature.

Cloud point indicates the temperature at which wax crystals start separating from the fuel. This should also be below the lowest expected ambient temperature, to prevent clogging of fuel filters.

High-viscosity fuels offer greater resistance to flow in cold weather, causing the pump to work harder. They may also affect atomization at the nozzle.

In cases where carbon formation appears to have been excessive, the fuel's *Conradson carbon* rating should be considered. No *direct* correlation exists between this test and the carbon formation in the engine. Yet, it is an indication of the carbon forming characteristic of the fuel and should be kept as low as practicable, all else being equal.

TABLE II

Fuel Oil Selection Chart

Type of Engine Application	Ambient Air Temp.	Distillation 90% Boiling Point (Max.) or Final Boiling Point (Max.)		Cetane Number (Min.)	Sulfur Content (Max. %)
Wide variation in load and speed, considerable idling.	Above −20°F	550°F	575°F	45	0.25
	Above 0°F	575°F	625°F	45	0.50
	Above +40°F	575°F	625°F	45	0.50
	Above +80°F	625°F	675°F	40	0.50
Intermediate load and speed, minimum idling.	Above −20°F	550°F	575°F	45	0.25
	Above 0°F	575°F	625°F	45	0.50
	Above +40°F	625°F	675°F	40	0.50
	Above +80°F	625°F	675°F	40	0.50
Heavy load and high speed, minimum idling.	Above −20°F	575°F	625°F	45	0.50
	Above 0°F	625°F	675°F	40	0.50
	Above +40°F	625°F	675°F	40	0.50
	Above +80°F	675°F	725°F	40	1.00

Ash content of the fuel is another quality that may be considered important. It consists of abrasive solids and soluble metallic soaps in the fuel. Both contribute to engine deposits. Abrasive solids also cause wear. This too should be held as low as practicable, everything else being equal.

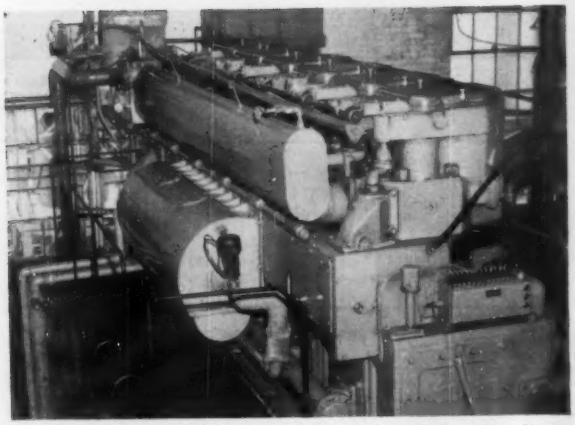
Water content of the fuel which causes wear and corrosion of the injection system and contaminates lube oil, seldom comes with the fuel. Most of it gets into the fuel during storage and handling. Careful storage and handling procedures will prevent most troubles caused by it.

Conclusion

Commercially available distillate fuels provide the qualities to meet requirements of engines in a broad range of operational conditions. All you do is select the least expensive one that most closely suits your engine service and operation.

For example, the accompanying fuel selection chart published by the Detroit Diesel Div. of GM Corp., (See Table II) gives the distillation, cetane and sulfur limitations for fuels suitable to their engines under various conditions. While specific to their engines, these recommendations are generally valid for all high-speed engines working under similar conditions and facilitate your selection of the correct fuel.

Fuel quality is a vital factor for satisfactory performance of high-speed diesels and long engine life. Yet, though suitable fuels must be clean, completely distilled, well-refined and non-corrosive, they need not be the most expensive on the market. The accompanying charts will help you select the least expensive fuel that meets your engine requirements—and so will the engine manufacturer and fuel oil dealer—if you ask them.



Enterprise Model DGSQ-36, dual-fuel, 1140-hp, 6-cyl unit after installing intake air cooler. Use of intercooler (below exhaust manifold at left of engine) boosted output and cut fuel consumption.

Value Of Intercooling

By L. E. Clark, Superintendent
Broken Bow Municipal Utilities, Broken Bow, Nebraska

COOLING intake air has boosted our engine capacity as much as 20%. It has also cut our fuel consumption about 10-15%. This is remarkable—especially when we realize that cooling of intake air probably costs less per hp developed than any other method of increasing engine output. Here are some practical applications of intercooling on our engines at the Broken Bow Municipal plant with examples of the benefits gained.

Prior to 1952, no intercooling equipment was installed on our 4-cycle, 16-in. by 20-in. bore and stroke dual-fuel Enterprise generating units. One of these is an 8-cyl engine rated 1460 hp, the other, a 6-cyl unit, rated 1140 hp.

Analyzing The Situation

To develop some background data and determine the benefits that could be obtained from intercooling, we installed instruments and tabulated all engine conditions for about a year. Accurate records were kept of ambient temperature, intake air manifold temperature, manifold air pressure and gas flow to each engine for all loads. This data covered the entire range of ambient temperatures from minus 20°F to 110°F. Curves developed from this data were quite interesting.

Briefly, here's what we found. When the smaller unit was operating at full load, temperature rise through the Elliott-Buchi turbocharger compressor was 100°F. This differential was the same for all ambient temperatures. In other words, if the outside temperature was 0°F, the engine manifold temperature was 100°F.

The larger engine operated with a 70°F differential in temperatures across the Elliott turbocharger. The 30°F lower temperature on this engine manifold, had always made it possible to carry a higher percentage of load than that carried on the other engine.

Manifold temperatures up to 200°F were recorded on both units. However it was impossible to carry full load using gas for fuel at these temperatures. By contrast, when operating on gas, with 0°F ambient temperatures it was possible to carry 20% overload and still have normal engine pressure and temperature conditions. Also, gas flows became progressively lower as manifold temperatures were reduced. This indicated that better efficiencies were possible at lower manifold temperatures.

Results With Intercooling

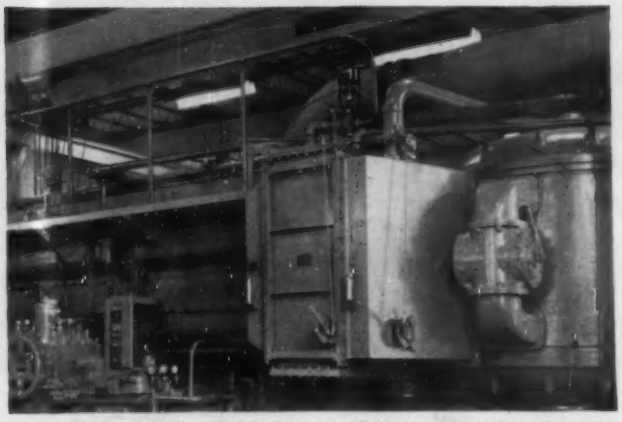
Encouraged by these results, A. R. Fliescher, research engineer of the Enterprise Engine and Machinery Co., was called to our plant in January, 1952, to study actual requirements for cooling intake air for these engines. These studies resulted in development of the original intercooler for the Enterprise engines. This was installed later that same year and has proved to be even more successful than anticipated.

This cooler, through which city water flows at 56°F, plus use of proper thermostats, maintain manifold air at 85°F. This temperature is maintained regardless of the load and ambient temperature. As a result, rated engine capacity was boosted 20% when working on natural gas.

Average fuel economies in terms of Btu per kwh have been improved 10-15% by intercooling. However, actual savings to the city far exceed those percentages. For example, the 8-cyl unit originally rated 1000 kw now develops 1200 kw. This gain of 200 kw was accomplished without any increase in cost of lube oil, pilot oil, repairs, or investment charges, other than cost of the intercooler, water to operate it and gas to produce additional power.

Assuming the benefits with intercooling in producing energy within the original 1000 kw to be at least equal to the water cost, generation within the added 200 kw costs only 2.5 mills per kwh, plus investment in the intercooler. This amounted to $18.00 per kw. When compared to buying similar capacity in new generating equipment, this is less than one-tenth normal capital costs. Costs of producing this extra energy are less than one-third normal production costs per kwh.

Intercoolers applied in air intake systems of dual-fuel engines in the Broken Bow, Municipal Power Plant boost power—save money.



Fairbanks-Morse 1200-hp, Model 33-FD-16, dual-fuel engine after Young 4-pass, ACY-78-4P cooler was installed. Air intake cooler (at left of scavenging pump located at extreme right) was assembled and installed by Broken Bow Municipal Plant engineers.

Intercooling Another Engine

An intercooler has also been installed on another generating unit in our plant, a 1200-hp Fairbanks Morse Model 33-FD-16 dual-fuel engine connected to an 800-kw generator. After about a year of investigating types and costs of various precoolers and intercoolers on the market, we decided to build our own.

Though the scavenging pump on this non-turbocharged unit delivers air at about 6000 cfm to the engine, much of this air is bypassed during partial-load operation. Thermometers were installed in the scavenging pump intake line and in the engine intake manifold. Records of these temperatures showed a differential of 50°F regardless of load and ambient temperature.

Engineers of the Young Radiator Co., were asked to recommend a standard design intercooler capable of maintaining manifold air temperatures of 90°F under all conditions when using 56°F cooling water. They recommended their ACY-78-4P cooling coil including the steel tanks and headers.

This 4-pass cooler having 124 Admiralty tubes, 5/8-in. diameter and 528 aluminum fins, costs $910. It is 50½-in. long, 27-7/8-in. wide, and 19½-in. deep. Most of the material for mounting the cooler and constructing the inlet and outlet housings was also purchased. This consisted of steel sheets, plates, straps and angles. A local welder did the welding and our own crew did the drilling, tapping and fabricating. The entire cost, exclusive of our own work, was about $1400.

This do-it-yourself method of building intercoolers is not generally recommended unless backed up by sound engineering. In most cases, the product built or recommended by the engine manufacturer should be selected.

A thermostatic valve in the incoming water line controls manifold air temperatures at 95°F. The temperature bulb for this thermostatic valve is located in the outlet air elbow for the intercooler.

Before cooling its intake air, this engine had not been too successful in using natural gas with the high ambient temperatures experienced in summer. It was only capable of pulling 75% of it's rated load. Intercooling has improved it so that 95% to 100% of rated load can always be carried on gas. This did not give us any extra overload ability but eliminated derating for moderate and high ambient temperatures.

Fuel economies in terms of Btu per kwh were improved by an average 20%. Cooling water at the present time is not separately metered from that used in the other engines. Its total cost for all engines is about $100 per month during the hot part of the year. This constitutes only a small fraction of a mill per kwh.

Figure The Payoff in Dollars

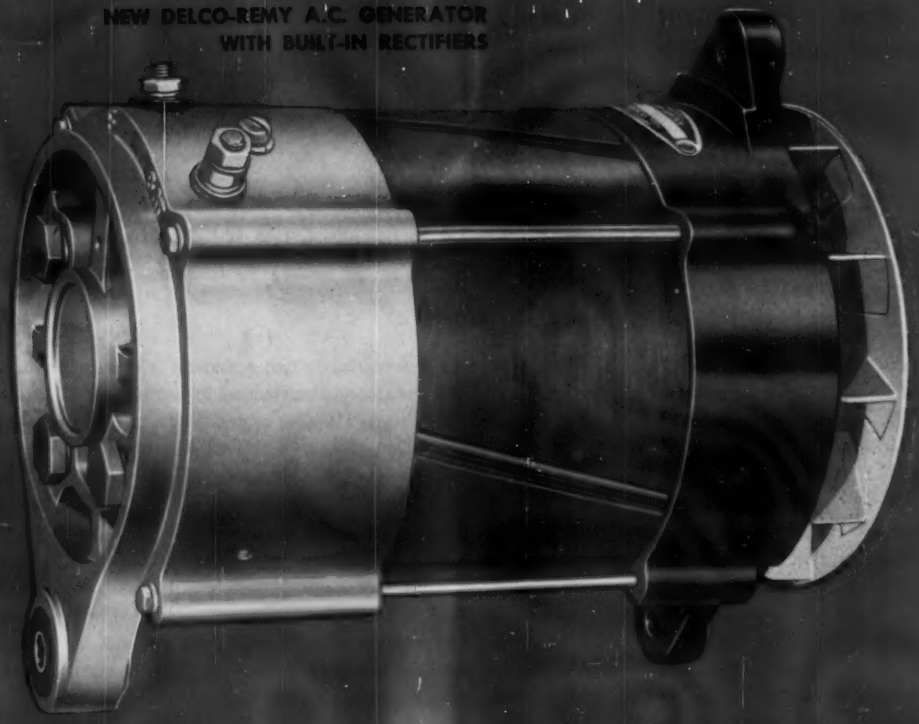
Many engineers and those who sell diesel and intercooling equipment are missing a good bet by not stressing the advantages in the added use of the cheaper of two fuels in this dual-fuel operation. Economies expressed in terms of Btu per kwh are all well and good—but what counts with the user is economy in terms of dollars and cents. Intercooling, for example, may produce a small improvement in Btu efficiency but can as cited previously, have a remarkable effect in savings in dollar cost. This can be emphasized with one further example.

Let's assume that natural gas is being used with an 800 Btu per cu ft low heat value and costs 25 cents per M cu ft. Also, that pilot fuel oil is being used with 140,000 Btu per gallon and costing 10 cents per gallon. In this case, 10 cents worth of gas contains 320,000 Btu, while 10 cents worth of fuel oil contains only 140,000 Btu. All the gains in capacity, previously mentioned, make possible added output while using only the lower cost fuel. This is the reason for the more spectacular savings.

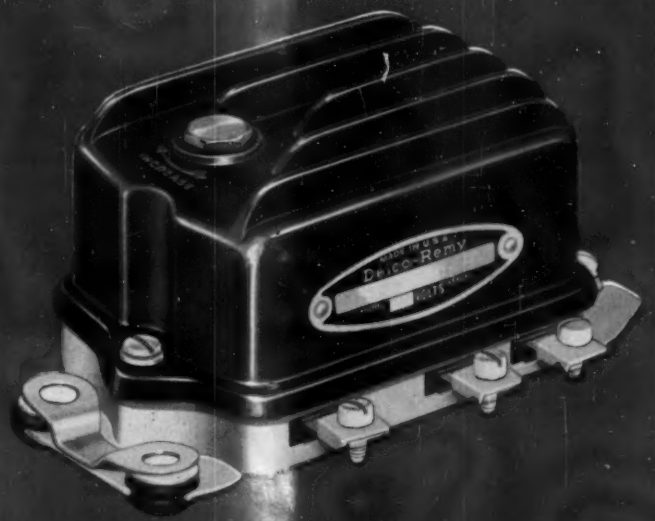
Intercoolers are standard equipment on nearly all dual-fuel engines purchased today. Intercooling would also be a valuable addition to most dual-fuel engines now in service.

ANNOUNCING A MILESTONE

NEW DELCO-REMY A.C. GENERATOR
WITH BUILT-IN RECTIFIERS



PROGRESSIVE ENGINEERING MAKES THE DIFFERENCE



NEW DELCO-REMY TRANSISTOR VOLTAGE REGULATOR WITH NO MOVING PARTS

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The compact new generator with its specially developed built-in silicon rectifiers can be installed quickly and easily with a minimum of change in standard d.c. electrical systems . . . offers a heavy charge at engine idle and up to *twice* the total output—with only a small increase in weight.

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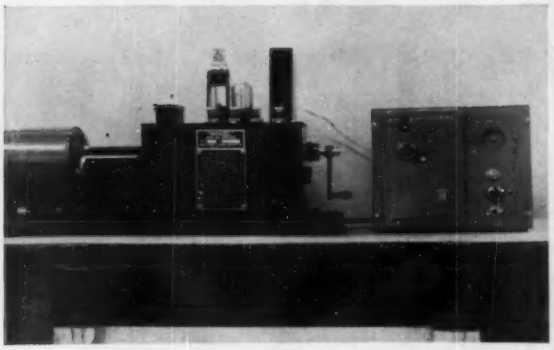


Manzel vacuum-type lubricator equipped with combination rotation shaft indicator and low-level alarm device. Control panel box at right contains both warning lights and a horn mechanism.

Lubricators Go Automatic Too

By Robert W. Meyers
Manzel Div., Houdaille Industries, Inc.

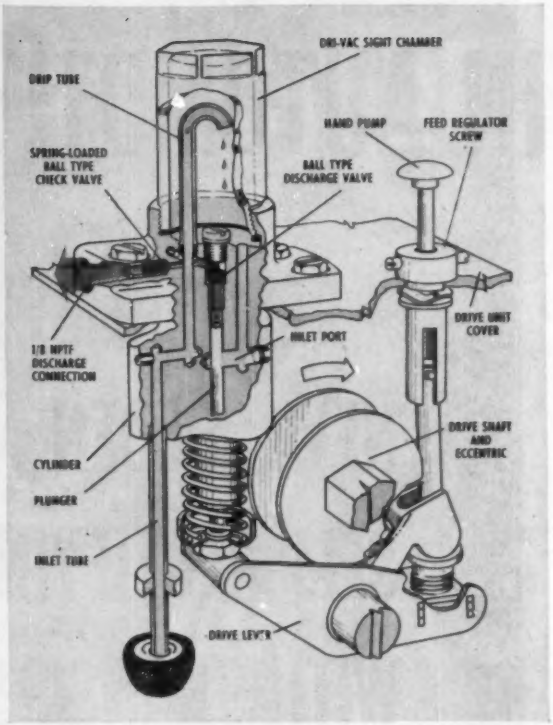
Trends toward automatic plant operation mean that all associated equipment must follow. Importance of power and compressor cylinder lubrication demands that mechanical lubricators have automatic features too. Here are details on the developments to meet these new needs.

AUTOMATIC plant operation puts new demands on all engine equipment. On engines with separate cylinder lubrication, mechanical lubricators are so vital to successful engine operation that there is little wonder that they have received special design attention. Not only must the proper amount of oil be delivered at the right point at the correct time but now there must be indication of continuous operation.

Sight-feed lubricators have undergone many changes, both to reduce maintenance and to improve accuracy of delivery. Both factors affect economy of operation.

Sight feeds are used to give visual evidence of delivery and to permit adjustment of the quantity of oil delivered. One maintenance problem has been clouding of liquid-filled sight glasses. Clouding became more of a problem as the use of high-additive oils for cylinder lubrication became more common. This defeated the purposes of sight glasses.

Various liquids were tried, with some success, to overcome the problem. However, there was still the cost of fluid and that for periodic servicing. One way out was



Manzel Model 82V vacuum pumping unit eliminates the liquid sight feed problem. Dri-Vac chamber gives perfect visibility.

to get rid of the fluid while retaining the sight feed feature. While this was being done, accuracy of delivery was also improved.

Insufficient oil delivery leads to cylinder scoring and excessive wear; excessive delivery promotes deposits and gumming of cylinder parts. Also, both conditions can exist in one cylinder where several delivery points are involved. One side of the cylinder can be flooded and the other side starved if delivery is not balanced among the lubricator elements involved.

A vacuum-type lubricator was built and went into service about three years ago. It has given evidence of helping to solve these critical problems. Its design and the added features to fit the lubricator setup for automatic operation will be discussed.

Vacuum-Type Pumping Units

In this unit, a vacuum chamber takes the place of the conventional liquid-filled sight glass. Vacuum is created during the downstroke of the pump's plunger and is proportional to the effective plunger stroke. Metering of the oil to be pumped takes place on the supply or low-pressure side of the pump. The difference between atmospheric pressure and the chamber vacuum determines the amount supplied.

The plunger has a constant stroke. Delivery quantity is adjusted by a conventional feed regulator. Its action is to locate the plunger higher or lower in the cylinder

with respect to inlet port location. Constant stroke with adjustment to vary the effective stroke is a principle used in many fuel injection systems because of its stroke-to-stroke accuracy even when handling minute quantities. It follows that it gives great accuracy when applied to lube oil pumping.

Plus this accuracy, there is less variation in drop size since there are no liquids, often of different densities, to influence them. Maintenance encountered with liquid-filled sight glasses is completely eliminated. Once feed regulation is set, the only servicing needed will be replacement at long intervals after normal wear has occurred.

Beside the economic value of this, it also makes these lubricators well suited for automatic or unattended operation. Incidentally, these lubricators will handle standard mineral oil base lube oils for compressor cylinder lubrication, or the special synthetics that are becoming more popular.

Controls for Automatic Operation

The first requirement for automatic operation is a continuous, controlled supply of lube oil to the lubricator's sump. This is done by an automatic float control installed in the lubricator reservoir. It controls a gravity flow from an overhead supply (a common tank or one for each lubricator) to keep the reservoir full at all times.

For maximum safety, this system should be monitored. Combination low-level alarms are used for this. They can be set in many ways. Electrical signals can be used to light a warning light, sound a horn, ring a telephone or even shut off the machine. Two low-level alarms may also be used. The first gives warning of a potentially dangerous condition. If this condition is not corrected within a selected time, the second alarm unit shuts the machine down.

Knowing that oil is available, it is then vital to know that it is being delivered. To do this, lubricator shaft rotation is monitored. A simple method of doing this has been worked out. This particular unit, consisting of a small pump, a bleed-down chamber and pressure switch, does double duty as it also tells if oil level is low in the lubricator reservoir.

As long as the lubricator's camshaft is turning and oil is available, the pump maintains pressure in the bleed-down chamber. This pressure actuates the pressure switch and supplies a constant signal. If the shaft stops or oil is low, the circuit is broken, a warning is given and the machine is put on "alarm" or shut down.

While different circuitry can be worked out, shutdown is logical when the vital nature of cylinder lubrication is considered. The various alarms come as optional equipment and are selected to fit the particular needs. They are suited for all lubricator models.

By use of these alarm systems, lubricators are made suitable for automatic and unattended operation. Plus that, they are an inexpensive way to protect a valuable piece of equipment.

Rough Terrain No Problem for Mobile Crane

M. A. N.'s truck-mounted diesel cranes have a unique appearance—compared to conventional ones. Their resemblance to a military tank is a tip-off on their ability to perform on rough terrain as well as on public roads.

Twin-diesel drive, using M.A.N.'s "whisper" engines, give the crane a 120-hp output and road speeds up to 50 kph. These engines, using the quiet-running "M" system, give minimum noise.

Full power or any portion of it is available for any crane motion, infinite speed variation and inching control in 4-speed ranges for all motions plus an extra low-travel range. Fingertip control of all motions is power-assisted (air-hydraulic) by only two universal levers. The chassis is available with 4-wheel drive and independent 4-wheel steering. All crane gears are of unit construction. They are easily accessible for convenient maintenance.

The cranes can be fitted with several types of rise "booms" and with grab buckets. The basic boom is 10 m long. It is of the sectional type and by fitting intermediate sections can be extended to 22 m. The possibility of supporting the rise "boom" on the undercarriage instead of the superstructure, using crane weight for stability, permits crane capacities, higher than standard ratings.

Typical units from M.A.N.'s line of mobile cranes were shown at the German Trade Fair in Hanover. Standardized components permit building of a large variety of units to suit specific uses and capacities. By using as many interchangeable parts as possible, spare parts requirements and stocking costs are reduced.

NEW! Simpler housing and one-piece bearing reduce maintenance on Thompson Turbocharger

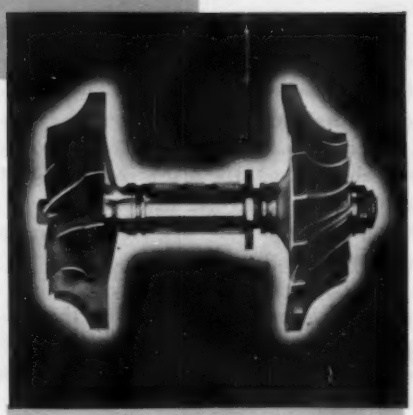
Designed for 10,000 operating hours under the severest operating temperatures and speeds. This means longer revenue runs between scheduled maintenance of the unit, and fewer unscheduled downtimes for repairs.

Turbine housing of the new Thompson Turbocharger is a heat-resistant alloy designed to eliminate corrosive attack and to be free from service cracks. Design also isolates high-temperature exhaust drive from bearing and air-side of turbocharger to increase maintenance-free life.

Bearing is one-piece design, mounted on small diameter shaft to reduce bearing surfaces speed even at high rpm.

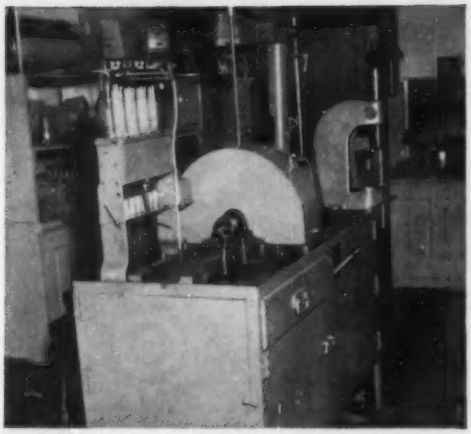
Design of impeller supplies supercharging air at equal compression ratios over a larger flow range and at lower rotor speeds than other turbochargers. Light-alloy rotor provides instant response to changes in engine speed and load.

Your blown diesel engines up to 300 horsepower can be readily equipped with new-design Thompson Turbochargers. Our engineers will help. When may they call?

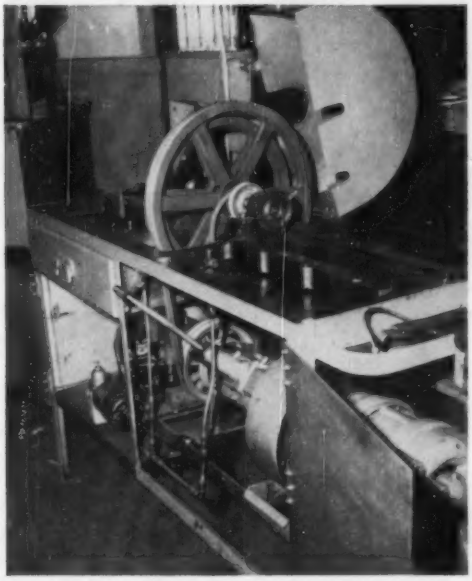


Write today on your company letterhead for Booklet DP-858 which contains technical data on Thompson Turbochargers for blown diesel engines up to 300 horsepower.

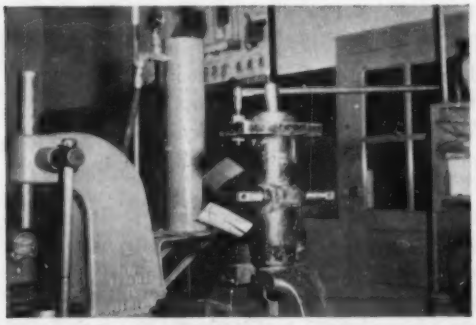
TAPCO GROUP
Thompson Products, Inc.
CLEVELAND 17, OHIO



John W. Walton, Sr. built this calibrating stand in 1940. It is still used. Some changes were made in spray-collecting gear and adapters but the basic stand is the same.



Motor drives pump through an automotive transmission and belting arrangement. Ratios were figured to give proper test speeds. Heavy flywheel gives smooth, constant drive.



Shop-built adjustable lever fits different size pumps. Plunger spring is compressed to get at retaining ring.

"Talking Shops"

Another DIESEL POWER interview to find new shop ideas. The shop—Fuel injection repair facilities of John M. Walton, Inc., New Orleans, La., one of the first American Bosch service facilities and their first distributor in U. S.

JOHN M. Walton, Inc. is a busy place. They are distributors for many lines and have repair facilities for fuel injection equipment, carburetion and electrical equipment, in fact for all lines which they handle.

John M. (Bud) Walton, Jr. president and Laurence H. Bohne, secretary and sales manager gave us the grand tour. We then got together with Joe Miller, service manager, to cover the fuel injection setup. As would be expected, the shop was well equipped, spotless and conveniently arranged. However, a detailed description of the shop was not our purpose as we explained in our first question—

"Joe, there is a certain similarity in all fuel injection shops since they're all doing essentially the same work. I'd like to concentrate on some of the off-beat items—things you have built or modification to equipment that speed up or improve the work."

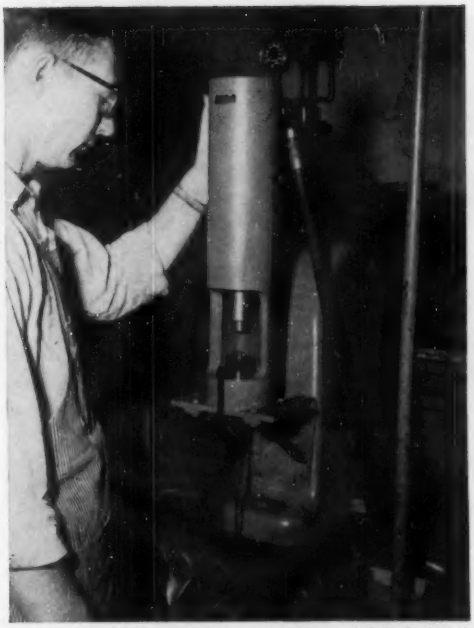
"Then one of the things you'll be interested in is this test stand. It certainly speeded up work and did a better job when it was built in 1940. Before calibration stands were readily available and you had no choice, Mr. Walton, Sr. hand-made this stand. We still use it.

"Some later ideas have been added but it is basically the same stand. Drive speeds are changed with an automotive transmission and plenty of flywheel was used to maintain a smooth, even speed. It's not as fancy as some modern stands but it is accurate."

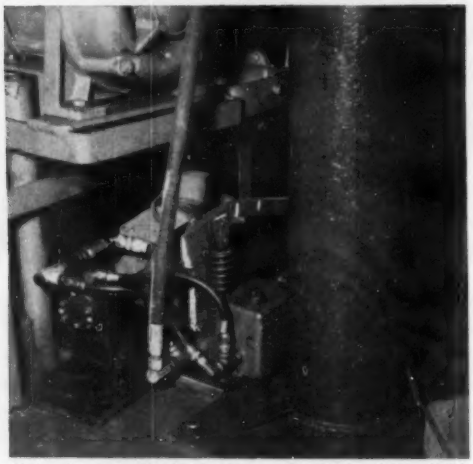
"Are you interested in small, special-purpose tools?"

"Certainly, and that special lever device as well as that nozzle holder in the vise look interesting."

"I don't know if that lever is new but we built it here and it's a real time-saver. As you can see, it is adjustable to most of the individual-type pump sizes. It's a simple

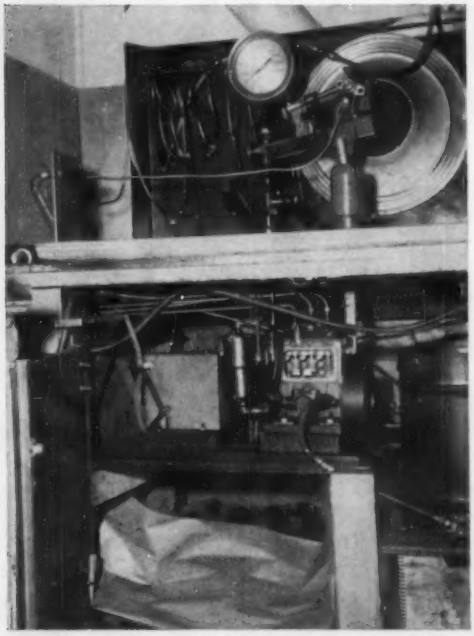


James Hollier demonstrates speed of modified hydraulic press used for swaging ends of high-pressure lines. Oil pressure from hydraulic pump (line shown) runs ram down fast and starts swaging operation. Final swaging pressure, shown by the gauge at top, is supplied by pedal action.



Motor-driven hydraulic pump was tied in with suitable valving to pedal-operated oil pump of press. Swaging time was cut from 7-10 minutes to 1½ minutes per end.

Special holder for AKC nozzles during assembly or disassembly. Hex recess at right holds nozzle body, recess at left, spray tip. Fixture is hardened for long life.



Motor-driven pump with variable speed and adjustable rack control supplies oil for nozzle run-in. Three plunger sizes are installed in pump. Nozzle is connected to right size.

way to hold down the plunger guide cups while taking out and putting in the retaining rings. It's easy to make and is a great convenience.

"This jig in the vise has been used for 15 years to good advantage. It's a holder for disassembly and assembly of AKC nozzles. We've had a lot of these nozzles from Superior engines. It holds the body and also has a recess for the spray tip.

"When it was made, it was hardened for long life. We've taken it for granted but when the Association of Diesel Specialists held their meeting in New Orleans several members thought so much of the idea that the Association has since published a bulletin with a drawing and dimensions."

"I notice you make up a lot of high-pressure injection lines. What's the story?"

"As a central distributor, our authorized service stations get all their parts through us. One item that we can provide is high-pressure tubing, made up in all shapes and sizes. To make these, we use a hydraulic press and swaging tools. We have the dies for all sizes up to ⅜-in. tubing.

"Incidentally, you'll be interested in a modification to this press. The ram has to be raised pretty high to get the tubing all set and it takes time with pedal operation to bring the die in contact with the tubing end. We found that it was taking from 7 to 10 minutes per end. So we started thinking.

Adjustable fixture holds "R", "S" and some "T" nozzles for run-in and spray test. Spray is caught in collector. Oil drains back; vapors are carried away by duct and fan. Pop tester is located here for checking opening pressures.

"We got a motor, a hydraulic pump, valves and tubing and hooked it up to the ram feed. Turn this on and the ram runs right down and the die starts the swaging operation. Swaging can be tricky. Too little swaging and you get a bad end; too much you may get cracks.

"Pressure is used to control swaging. The hydraulic pump will not give the full pressure required so we watch the pressure gauge and complete the swage accurately with a few pedal strokes. We can now make a line, both ends, in an average of three minutes."

"Cuts both time and effort. Good deal. Now, what about this nozzle tester?"

"As you can see, it is not a standard tool. We built it. A motor-driven pump, below the bench, is arranged to give us from zero to 700 rpm and rack setting from zero to 14-mm. It's a 3-plunger pump with 7-mm, 9-mm and 11-mm plunger and barrel assemblies installed. Each delivery outlet is connected permanently to a coupling board on the bench.

"Run-in and spray check can be made on 'R', 'S' and some 'T' size nozzles. A nozzle is mounted in an adjustable fixture, aimed at a target-collector and connected to the right pump plunger coupling. We find that ability to actually run the injectors is a good check on quality of the repair work and insures that they will run properly when installed.

"That pretty well covers all of what you might call the 'special' items—at least, all I can think of now. Think you have some worthwhile ideas for your readers?"

"Sure do. And Thanks. I'm sure that some will adopt the ideas directly or start thinking about how to adapt the principles to their operation."

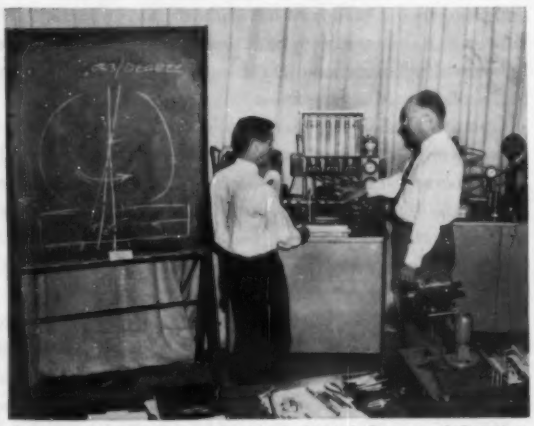
Jim Britton, (pointing to test stand) explains factory developed techniques to men in class held at Diesel Control Corp. shop.

RoosaMaster School Goes To The Field

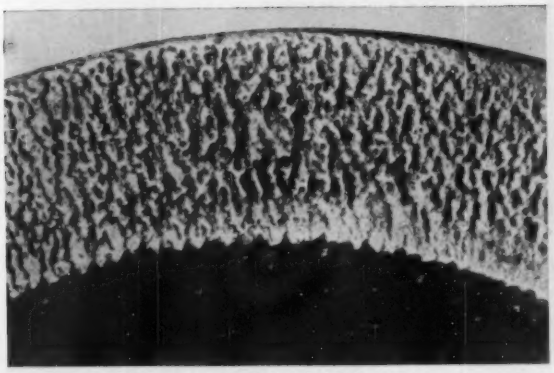
It's more practical and less expensive to take a school to the students rather than the students to the school in some cases. This was proven when Jim Britton, service manager of the Fuel Injection Div. of Hartford Machine Screw Co., went to teach a 22-man class at the Diesel Control Corp., in Wilmington, Calif. It would have been too expensive to send the 22 men to Hartford, Conn. for a week of instruction on RoosaMaster injection equipment.

These diesel engine specialists represented 16 fuel system service agencies, engine manufacturers, diesel fleet users and military services.

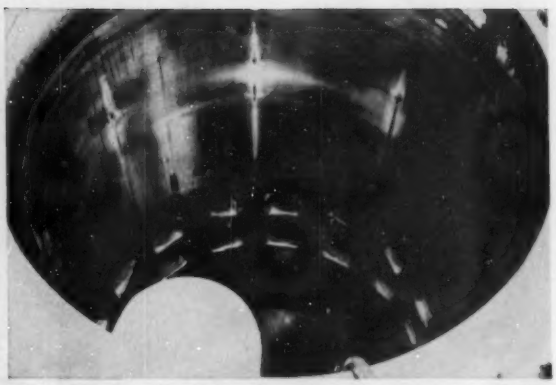
Jim Britton's mission was to acquaint these men with the operating, maintenance, repairing, test and trouble-shooting techniques developed by his company for the RoosaMaster pump and governor.



Stan Franklin, owner of the Diesel Control Corp., and Secretary of the Association of Diesel Specialties, Inc., (A.D.S.) is seen discussing RoosaMaster injection equipment with Jim.



Corrosion of diesel engine valve head. Sodium and vanadium cause early damage of poppet-type valves through what appears to be a corrosive attack or metal leaching like that shown above.



Intake port deposits resulting from incomplete combustion of fuel oil restrict flow of scavenging air into the cylinder. Note also the condition of the five cylinder lubricant injection holes.

New Problems—New Oils

By John V. Kalb, Research & Technical Department
The Texas Company, Beacon, New York

Control of wear and corrosion in engines burning heavy fuels require a new approach in lubrication. Here's data on development of one oil tailored to meet the problems.

COMPARE diesel engine performance characteristics of even 10 years ago with those of today. Trends of development, spurred by economics and competition, are plain to see. Higher specific outputs, greater reliability and improved operating economy stand out.

Large low-speed engines have shared in these developments. Higher outputs are being attained. Higher pressures through turbocharging, first of 4-cycle and now of 2-cycle engines, are being delivered as they work faster at the higher rotative speeds.

Reliability has been improved despite the higher pressures and rubbing speeds. Engineering refinements and improved metallurgy have played an important role. However, oil companies have made major contributions by providing lubricants capable of meeting the increasingly severe requirements.

Operating economy involves several factors. One is the engine's ability to squeeze more work out of the fuel. Thermal efficiency is basically a design problem. However, operating economy also includes unit costs for fuel and maintenance bills.

One marked trend is in the direction of reducing the fuel bill by using poorer grades of fuel, including No. 6 fuel oil—Bunker C. Historically, as poorer fuel is used, wear rates, corrosion, deposits and, thus, maintenance costs tend to increase. A major contribution of the oil companies has been to provide better lubricating oils that enable these engines to live with this fuel and do so economically.

This development work on improved lubricants, as in the case of diesel engine developments, is a continuing process.

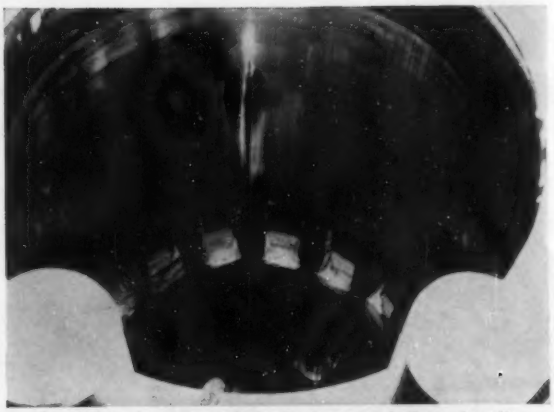
Some Basic Problems

Problems of burning residual fuels have been well publicized. Since the characteristics of such oils are so variable, there is no one pat answer covering all cases. All that emerges is a pattern.

Fuel cleaning and preparation are essential. Heating to varying degrees is involved in all cases to reduce the oil's viscosity for pumping, centrifuging and for the requirements of proper injection. Heating is also a factor in getting completeness of combustion. Incomplete combustion results in power loss and leads to severe deposit conditions.

Metallic components of the oil are troublesome in different ways. Sodium and vanadium, either alone and particularly together, lead to corrosive attack on cylinder components, especially valves. Reduction in sodium content may often be accomplished by water-washing but you are stuck with the vanadium. Additives, applied in both fuel and lubricating oil, have produced beneficial results in some cases.

Another normal characteristic of heavy fuels is their high sulfur content. Many experiments have demonstrated that high wear of cylinder liners (particularly cast iron) and rings will result from burning of fuels with high sulfur content at normal engine temperatures. Dur-



Incomplete burning of fuel oil also caused these deposits restricting the area of exhaust ports. Condition of three injection holes for cylinder lubrication is clearly seen.

TABLE I

Analyses of Fuel Oil Samples

Sample No.	56-8427	57-263	57-1878	57-2562	57-2563
Gravity, °API	12.9	9.9	9.8	11.0	9.9*
Water, %	Trace	0.1	0.3	0.4	3.2
Flash, PM, °F.	178	170	194	180	216*
Pour, °F	25	50	50	35	45
Viscosity SUF at 122°F. Sec.	167	197	186	195	162*
Carbon Residue, %	8.0	17	14.9*	14.9*	17.0*
Ash, %	0.03	0.06	0.06	0.02	0.9*
Spectrographic Analysis, PPM					
Calcium	40	24	19	80	113
Iron	19	23	22	24	130
Nickel	16	18	16	16	28
Silicon	--	60	100	100	400
Sodium	--	33	56	24	338
Vanadium	12	27	34	20	27
Sediment by Extraction					
Percent	0.01	0.06	0.07	0.04	8.17
Sulfur, %	1.48	2.27	2.26	2.48	1.83
Hydrogen, %	10.7	9.98	10.3	10.5	10.0

*On Water-Free Sample.

ing many early trials in use of heavy fuels, added maintenance cost due to high wear offset the major cost advantage of the cheaper fuel.

As a result, much development work has been done to determine the mechanism of this wear. It has been learned that a lot of the wear rate results from corrosive attack of sulfurous combustion products. Increased engine cylinder temperature aids in reducing this attack, but in many large engines the high temperatures necessary cannot be tolerated. An alternative approach is the design and application of cylinder lubricants for the prevention of this corrosive wear.

Developing New Cylinder Lubricants

In an attempt to reduce liner and ring wear when heavy fuels were used, many different qualities of lubricants have been tried, ranging from straight mineral oils to very high detergent type oils. Little if any change in wear was recorded. This work indicated that a cylinder lubricant, to successfully lubricate a large slow-speed diesel, must have characteristics to do the following jobs:

1. Provide neutralizing capacity to resist corrosive attack of sulfurous combustion products in cylinder and ring metals.
2. Demonstrate extreme pressure properties.
3. Spread over cylinder surfaces.
4. Lubricant combustion products of the lubricant itself should not injure engine metals.

One early product developed was an *emulsified* oil containing approximately 20% water with calcium salts dissolved in the water phase. Testing showed that this product effectively reduced cylinder wear and it is widely use for this purpose. However, as with most emulsions, this product was relatively unstable, tending to separate. Separation of components under the many conditions of storage and handling continues to be a serious problem.

A second non-conventional type of lubricant developed consisted of a *dispersion* of calcium salts in the lubricating oil itself. This product also is effective in wear reduction and is widely used. Being a dispersion it also suffered from the problem of separation in storage and handling.

These conditions suggested the desirability of developing a homogeneous lubricant which would avoid unusual storage and handling problems yet incorporate the corrosion-neutralizing characteristics that the emulsion and dispersion types demonstrated.

Many lubricants have been developed and subjected to laboratory engine tests. One found particularly suited for the application contained a newly developed additive which was wholly soluble in lubricating oil. This product, referred to herein as Experimental Oil X, was subjected to field testing.

Field test results are from a diesel engine installed in power plant service operating 24 hours per day. The engine is a 2-cycle, 5 cyl, 21½-in. bore model with trunk-type pistons. Each cylinder is equipped with an individual 6-barrel lubricator which enables use of different oils in the various cylinders during each test period. This permitted a direct comparison of cylinder lubricating oil performance in the same engine during the same test interval. This is most necessary for a true comparison since fuel quality, engine operation and other factors can and do vary from one test period to the next in commercial operation.

Quality of the fuels used is shown by the analysis of five samples taken at various times from storage (Table I). These fuels are the commercial Bunker C type. Note that the gravities varied from 9.8 to 12.9° API, with the majority of fuel consumed in the range of 10 deg API. This is the gravity of water. Since fuels of this type normally contain some water contamination, close correspondence between gravities of the fuel and water makes removal of the latter by centrifuging very difficult. This situation points up the problem of fuel conditioning and necessity of incorporating adequate heating, centrifuging and filtering facilities to

TABLE II

Physical Tests on Cylinder Lubricants

	Heavy Duty Oil A	Heavy Duty Oil B	Experimental Oil X
Flash, COC, °F.	460	460	500
Fire, COC, °F.	500	500	560
Gravity, °API	24.5	24.8	23.2
Viscosity, SSU			
at 100°F.	939	995	825
at 210°F.	75.9	81.7	78.5
Ash, %	0.31	0.58	2.9

prepare the fuel for delivery in a clean condition to the engine.

Table II shows physical tests on two heavy duty oils and Experimental Oil X. Heavy Duty Oil A and Heavy Duty Oil B are conventional MIL-L-2104A type lubricants. Experimental Oil X, while different in composition, was specifically formulated to combat corrosive wear from combustion products.

Experimental Oil X was evaluated during three test periods. Cylinder liner wear are shown in Table III. Note from a vertical comparison in any column that liner wear in the same cylinder with the same lubricant varies from test period to test period. These variations occur largely because of changes in quality and condition of fuel delivered to the engine and variable engine loads. It is considered that the most valid relative wear performance is gained by this comparison of relative wear occurring during each test period.

It was found that reduction of liner metal removal with Experimental Oil X was also accampanied by reduction in ring wear. During the 1450-hr test period, loss of metal on the radial ring dimension was checked and is shown in Table IV. Reduction in radial wear is striking, particularly for the rings with higher wear.

TABLE III

Effect of Oil Type on Wear of Cast Iron Cylinder Liner

Cylinder No.	1	2	4
Lubricant	Heavy Duty Oil B	Heavy Duty Oil B	Experimental Oil X
Run D (595 Hrs.) Thousandths in. Wear/1000 Hrs.	18	8	5
Run E (1064 Hrs.) Thousandths in. Wear/1000 Hrs.	15	15	3
Run F (1450 Hrs.) Thousandths in. Wear/1000 Hrs.	14	10	5

TABLE IV

Effect of Oil Type on Piston Ring Wear (Cast Iron Liners)

Maximum Radial Ring Wear — 1450 Hour Test Thousandths in. Wear/1000 Hrs.

Lubricant	Heavy Duty Oil B	Experimental Oil X
No. 1 Compression Ring	202–259	56–56
No. 2 Compression Ring	117	12–33
No. 3 Compression Ring	57	8–17
No. 4 Compression Ring	12	6–6
No. 5 Compression Ring	15–16	8–11

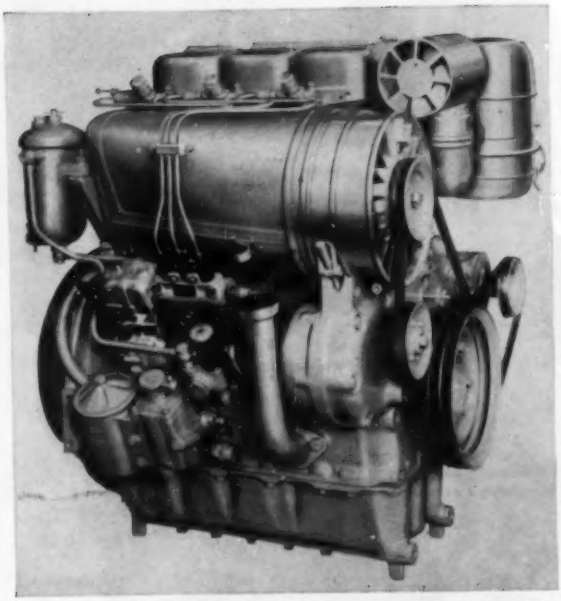
Effect of lubricant on liner wear is shown graphically. This graph shows wear as the increase in maximum cylinder dimensions for each of three cylinders operating on different oils.

During the first 1223 hours, cylinders 1 and 2 were operating on two different but conventional heavy duty oils and cylinder 4 on Oil A. During the next 1028 hour period, all three cylinders operated on Oil A. During the following three test periods, Heavy Duty Oil B was used in Cylinders 1 and 2 and Experimental Oil X was used in Cylinder 4. The striking leveling-off of the wear rate with Experimental Oil X as compared to the other three lubricants is clearly shown.

In utilization of some special types of cylinders oils in marine diesel service, rapid increases in bearing metal corrosion tendencies by the supposedly-separate crankcase oil have been observed after relatively short periods of service. Analysis of these crankcase oils indicated they had been contaminated with the cylinder lubricant. During the testing period, small quantities Experimental Oil X were found in the crankcase lubricant as is to be expected with a trunk-type engine design. Frequent analysis of crankcase oil condition indicated no adverse effects.

Summary

Trends indicate that diesel engines of increased horsepower, obtained largely through supercharging and turbocharging, will be available over a wide range of power. Improved lubricants have been developed that add substantially to ring and liner life in large low-speed diesel engines operating on heavy fuels with high sulfur contents. New lubricants will make the diesel a more efficient consumer of the economical heavy fuel and will accelerate this trend to heavy fuel in both marine and stationary power plant service.



The 3-cyl Model 712 Deutz diesel is the smallest of the three models added to the 712 Series. Others added were 4- and 6-cyl units.

Deutz Adds Three 712 Series Models

Five Series 712 Models now broaden the range of application for these air-cooled diesel engines.

MODEL 712 air-cooled Deutz diesels now come in five sizes. Three new Models—the F3L712, F4L712 and F6L712 have been added. The original two Models were the F1L712 and F2L712—1- and 2-cyl engines. These units are made by Kloeckner-Humboldt-Deutz A.G. of Cologne, West Germany, and distributed in the U.S. by the Diesel Energy Corp. of N.Y.C.

The new models are 3-, 4- and 6-cyl, vertical, in-line, 4-cycle engines with a 3¾-in. bore and 4¾-in. stroke. Like the other two models, they have a piston displacement of 52 cu in. per cylinder and a compression ratio of 17.5 to 1. (For dimensions, weight, and output and torque ratings see Table I)

TABLE I

	F3L 712	F4L 712	F6L 712
Height in inches	33	33	33
Width in inches	25	25	25
Length in inches	30	35	48
Weight in lb *	616	693	902
Intermittent hp at 2800 rpm	45	60	90
Continuous (24-hr) hp at 2300 rpm	33	44	66
Maximum torque lb-ft at 2300 rpm	93.5	123	184
Fuel consumption lb/bhp/hr at full load	0.407	0.407	0.407

* Weight includes all standard accessories and electrical starting equipment.

Cylinders, cylinder heads, pistons, connecting rods, valves, rocker arms, bearing inserts, etc., are interchangeable among all five models. Maximum use of this interchangeability feature simplifies stockkeeping and maintenance.

The combustion chamber used on these engines is the Deutz L'Orange swirl-type. Glow plugs permit cold weather starting down to 40°F below zero.

The fuel injection system consists of a Robert Bosch injection pump with fuel feed pump, a filter and pintle-type nozzels. For variable-speed applications such as automotive, cranes, etc., the injection pump drive is equipped with an automatically-synchronized injection advance. The governor is also made by Robert Bosch.

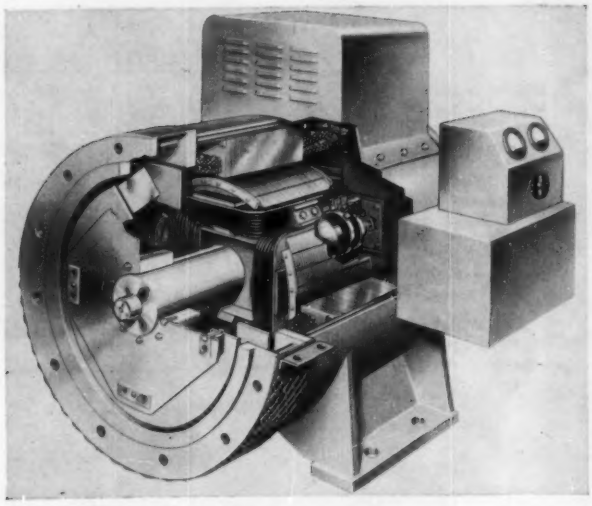
The cooling system consists of a vee-belt-driven axial-flow blower. Vee-belt failure initiates a visual and audible warning signal on automotive units. Industrial engines have an automatic shut down device to stop the engine in case of vee-belt failure. Use of these safety devices is vital since even momentary engine operation without the blower will result in serious damage.

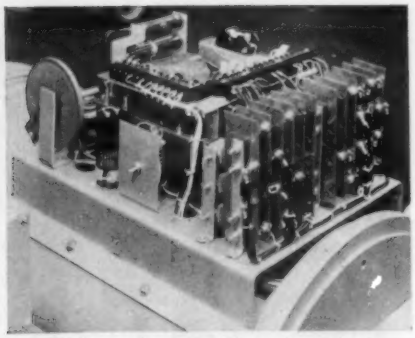
All moving parts are pressure lubricated. A full-flow "Autoclean" filter with a secondary micron filter are always used. Use of a lube oil cooler is optional on the 3-cyl models. However, on the 4-cyl units it is required at speeds over 2300 rpm and on 6-cyl engines it is always used.

An electrical starting system is standard equipment on all models. An inertia starting system is optional. The electrical system consists of a 12-v starter and 12-v generator made by Robert Bosch, a voltage regulator, glow plugs and glow indicator, and a 2-stage starter switch.

The new models are designed for off-highway vehicles, construction and farm equipment, generator, pumping and compressor sets, marine propulsion and shipboard auxiliaries. The standard SAE #2 or #3 flywheel and bell housing used on the new units make them adaptable to any of these services.

A network of distributors and dealers is at the customer's disposal throughout the U.S. for the sale of these units and spare parts, and for servicing them.





Static exciter regulator gives close voltage regulation with no moving parts.

Cutaway shows static exciter regulator (upper left); control box with inclined meters; cable connection box (under control box); rugged oversize shaft; rolled steel frame; flat-plate end shield with air inlet cover; and internal components and windings.

Generators Designed For Diesel Drive

By P. G. Cummings, Application Engineer, Medium AC Motor & Generator Dept., G. E. Co., Schnectady, N. Y.

What design features are considered important to suit generators particularly for diesel drive? A G. E. engineer gives his answers.

"DESIGNED for diesel-engine driving." Applying this to a new line of a-c generator power packages, what does it mean? What features did General Electric Company engineers think important in the design of these new units, primarily for this particular application?

First, ratings. Generator capacities had to be in ranges commonly required of diesel generator sets. Then, they had to be designed to produce 60-cycle current at the normal speeds of diesels suitable for driving them. The new line is available in 60-cycle ratings for 219 through 375 kva at 1800 rpm and 187½ through 250 kva at 1200 rpm.

Compactness and lightness are important as many sets in this size range are mobile or transportable. Use of a rolled-steel fabricated frame and flat plate-type end shield contributed here.

Flexibility for multi-purpose use and ease of installation are desirable features. These generators come in either single-bearing construction with integral SAE adapter and flexible disc-type coupling, or two-bearing construction with shaft extension. In either case, installation is simple. Access to brushes and slip rings is through an inspection cover on the rigid end shield.

Ventilation for adequate cooling over a wide range of conditions is essential. Here, flow is axial with air taken in through louvered openings in the end shield and top-mounted exciter. It is discharged through a screened opening on the coupling end. A protective cover over the coupling and fan end helps prevent entry of dripping liquids.

Ruggedness and reliability are essential. Attainment of these qualities was approached in two ways—first, in the structural and component design and, second, by holding moving parts to a minimum. Example of the latter will be seen in discussion of the electrical characteristics.

Different voltages must be provided. Each of these power units is suitable for operation at voltages of 208Y/120 volts, 4-wire, 3-phase, 60 cycles; or 400Y/230 volts, 4-wire, 3-phase and 200 volts, 3-wire, 3-phase, 50-cycles. Each is suitable for single-phase operation, either line-to-line or line-to-neutral. They will handle 10% overload for two hours. Cross-current compensation is supplied for parallel operation.

Following out the idea of holding moving parts to a minimum, the excitation system is static. The rotating exciter is eliminated. The regulator obtains power from the alternator's output, feeds it through a controllable reactor, and rectifies it. A full-wave rectifier circuit feeds the required d-c to the alternator field.

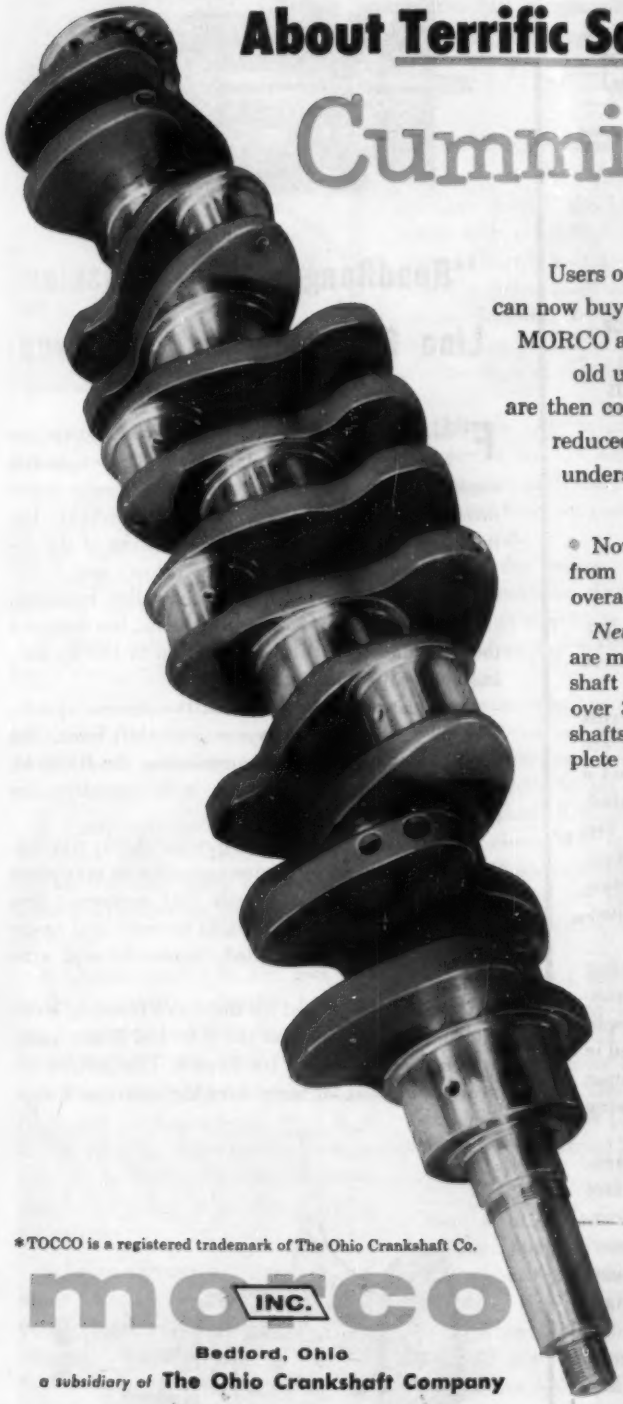
Close voltage regulation, an important requirement, is obtained with the static exciter. Its heart is the magnetic amplifier or amplistat. It consists of two main a-c gate windings and several d-c control windings, all wound on a laminated iron core. Output of the gate windings is connected to the load through rectifiers. Power from the a-c input passes alternately through one gate winding, rectifier and the load, and then through the other gate winding, rectifier, and load as a-c input reverses polarity.

Effective impedance of the gate windings can be controlled by direct current in the control fields. Control current can be introduced into the control fields in a direc-

(*Continued on Page* 30)

Important News

About Terrific Savings for Users of Cummins Engines



Users of Cummins "H" and "NH" Diesel Engines can now buy *new* standard size crankshafts from MORCO and secure liberal trade-in allowances on their old undersize shafts! These undersize shafts are then completely reconditioned and sold at reduced prices depending upon the degree of undersize involved. Your savings? Tremendous!

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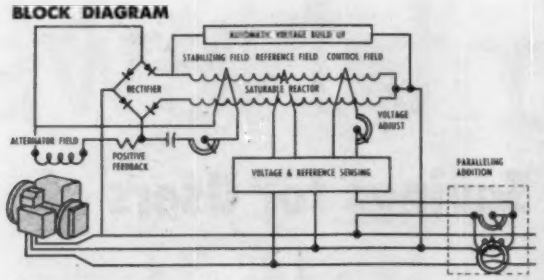
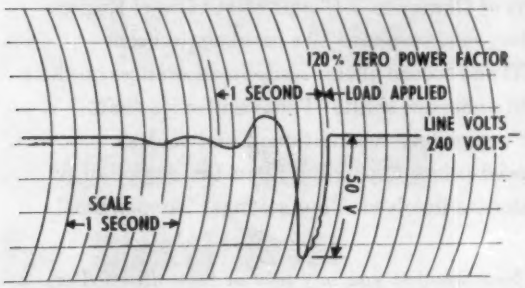


Block diagram shows complete circuitry for operation and control.

Brush recording shows response and recovery of the generator output voltage following instantaneous application of zero power factor load.



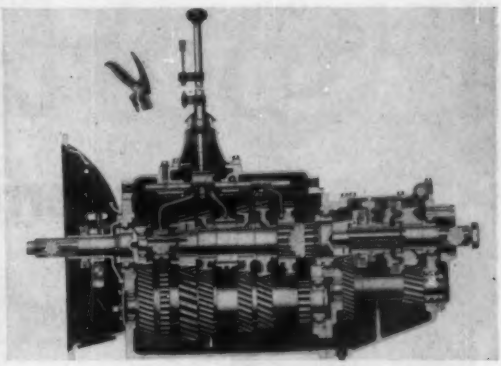
tion to either increase or decrease effective impedance. Output of the amplistat is a function of the net ampere turns in the control fields.

In the static exciter, amplistat input is connected across the generator output, and the d-c control windings are connected through rectifiers to a voltage reference and a voltage sensing circuit. Output of the amplistat gate windings is rectified and connected to the generator field. The voltage reference and sensing circuit combine to supply the required net ampere turns to the amplistat to maintain output voltage at a value determined by the voltage adjusting rheostat.

The package features 3-phase voltage sensing, enabling the regulator to regulate the average of the three line voltages. An additional control field in series with the amplistat output improves the overall gain and regulation, and in addition, a stabilizing field is connected across the output through a RC network to improve stability following transient load conditions.

Since the exciter regulator contains a minimum of parts, none of which are rotating or vibrating, it is virtually free from variations in service due to dirt, vibration, or corrosion. It consists of several rectifiers, a saturable reactor, resistors, and wiring all mounted in a drip-proof enclosure. It offers maximum of reliability, in addition to a high-gain, fast-response regulating system.

All of the factors discussed combine to produce generator packages "designed for diesel-engine drive". While primarily for this service, they can be used anywhere that their characteristics find favor.



"RoadRanger" Transmission Line Expanded And Improved

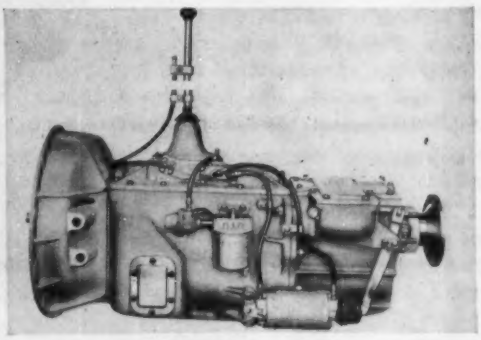
FULLER's line of RoadRanger transmissions has been expanded and improved. The expansion consists of the addition of two semi-automatic transmissions, the R-63 (see above) and R-630-D. The improvement is in weight due to making of the 10-speed, semi-automatic R-96 (see below) and R-960 Models with lightweight aluminum alloy housings.

Fuller Mfg. Co. of Kalamazoo, Mich., has designed the R-63 and R-630-D for diesels up to 185 hp having up to 630 cu in displacement.

Both feature 10 forward and two reverse speeds, with all ratios selected by one gear shift lever. The R-63 is a direct-in-tenth transmission, the R-630-D, a direct-in-ninth transmission with overdrive in tenth gear.

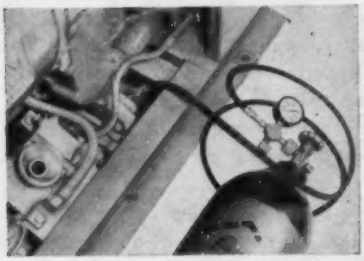
Other features are: easier, quicker shifts; elimination of gear splitting; engine operation in maximum horsepower range for greater fuel economy; less driver fatigue; space-and-weight savings; and range shifts which are pre-selected, automatic and synchronized.

Aluminum alloy used for the clutch housing, front case and auxiliary case of the R-96 and R-960 units, reduces their weight by 160 lb each. This permits increased payloads for many over-highway operations.



service section

Recent engine and equipment modifications, procedures and recommendations straight from the different manufacturers to you



GM Hydrostarter Charging Kit Use

The following instructions covering the use of the GM Hydrostarter charging kit have been prepared to illustrate the simplicity of checking or recharging the accumulator.

1. Attach indicator end of charging kit to nitrogen tank.

2. Remove air valve cover from accumulator cap and hex cap from valve stem. Install valve stem extension on valve stem.

3. Completely back-off shaft pin in air chuck valve connector on charging kit line and install connector on valve stem extension. Draw swivel nut up tight.

4. Loosen the 5/8-in. hex lock nut on the accumulator valve stem by turning it counterclockwise. Do not turn lock nut more than 1 1/2 turns.

5. Turn shaft pin in air chuck valve connector clockwise until valve core in air valve is depressed. If there is any charge in the accumulator it will register at this time on the charging kit gauge.

6. Crack valve on nitrogen tank and allow a small flow of nitrogen to enter into the accumulator until the charging kit registers 1300 psi. Close nitrogen tank valve.

7. To check precharge during charging, shut off valve to nitrogen tank, allow a little time for pressure to stabilize and the pressure indicated on the gauge is accumulator precharge pressure.

8. When accumulator is charged, back-off shaft pin in air chuck valve and tighten 5/8-in. hex lock nut on accumulator valve stem. This isolates the pressure in the charging kit line. Depress bleed-off valve on gauge to reduce the pressure in the line to zero.

9. Repeat steps four and five to check for a precharge of 1250 psi.

10. Disconnect accumulator charging kit from the accumulator and from the nitrogen tank.

11. Check for gas leakage by applying a soap solution to the accumulator valve stem.

12. Replace hex cap on valve stem and install air valve cover on accumulator cap.

Cleaning Cummins PT Injectors

Carboning of PT injector metering orifices restricts the fuel flow to the cups with a resultant loss in horsepower. Here is a simple method of removing carbon from the orifice by reverse flushing. It should be done on a warm engine.

The steps in the procedure are as follows:

A. Loosen all injector adjusting screws one (1) turn from bottom or one and one-eighth (1 1/8) turns from set position. Lock the jam nut.

B. Start the engine and accelerate with maximum throttle from idling to high-idle 10 to 15 times.

C. Readjust injectors to standard settings.

The engine will be difficult to start with the loose injector setting; it will smoke badly and will be sluggish. When injector is set with adjusting screw backed off, metering orifice will not be closed during injection. Extremely high injection pressure will force some of the fuel to back-flow through the orifice and remove deposits.

This is a quick method that may be of particular value for solving low power complaints of vehicles on the road. It may prevent removing a unit from service and save time and labor expense. The entire procedure can be performed in about 30 minutes.

New Oil Rings For Cat Diesels

A spring-loaded oil ring is now being used on the pistons of D315 and D318 Engines, D4 and D6 Tractors, No. 955 and No. 977 Traxcavators and No. 12 and No. 112 Motor Graders. The spring-loaded oil ring has greater flexibility and provides better oil control over the entire operating range of the engine than the former ring.

The new ring can be used as a direct replacement for the earlier oil ring.

Installing Crankshaft Gear On IH Diesels

Due to the close tolerances between the outside diameter of the crankshaft and the inside diameter of the crankshaft gear, extensive damage may be caused if the gear is allowed to become cocked on the crankshaft when installing.

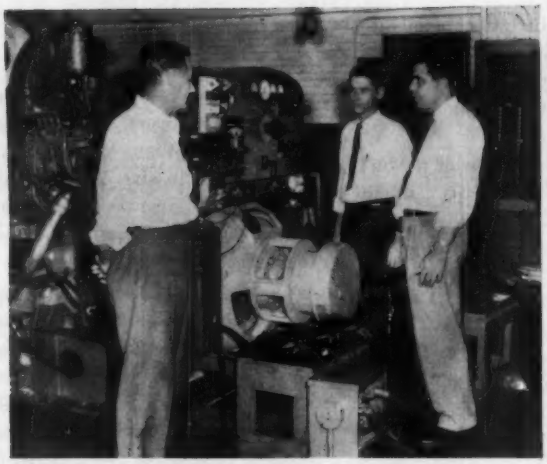
On all 4-cyl IH diesel engines equipped with straight-bore crankshaft gears (not tapered), the crankshaft gear should be heated to 250°F before attempting installation. This will facilitate assembly and reduce the possibility of galling the inside bore of the crankshaft gear.

industry news

Diesel Taxi Owner Speaks

One of the letters received by Diesel Power, relative to the article, "And Now—Diesel Taxi Cabs", (published May 1958), was from A. J. Sivers, Washington, D. C., an owner of a diesel cab. Here's what he had to say.

"I received my Mercedes-Benz, 180D, diesel-powered cab in March 1958. Since that time my fuel costs have dropped considerably. By buying 250 gallons of diesel fuel at a time, I pay 19.1 cents per gallon. Since the cab runs about 26 mpg, it costs only about 60 to 75 cents to travel about 75 to 100 miles a day. When operating a gasoline engine powered cab, my fuel bill was about $4 a day to cover about 100 miles."



Hercules Engines Undergo Rigid Testing

Before shipping automatic generator sets, complex tests are made to assure that they conform to the customer's rigid specifications.

An engineer of the Bell Telephone Laboratories, an inspector of the Western Electric Co. and a Hercules representative are watching such a diesel-generator set undergo test at the Hercules Motors Corp. plant in Canton, O. The unit under test is the 475-hp Model TCD-1468 engine, one of the largest made by Hercules.

The engines power standby generator sets in the 150-200-kw range. These automatic units are for emergency standby use in telephone exchanges. In event of power failure, a switch is activated which starts the diesel and then cuts the generator set into the power supply line.

Trademark Comes To Life

There's a lighter side to even technical society meetings. Take the recent Oil and Gas Power Div. ASME, Conference in Philadelphia. Following the technical sessions there is opportunity for those in the industry to get to know each other better.

Someone knew the trademark, used by Wm. W. Nugent & Co. for many years, of the man in the cap with an extended oil can, rushing to deliver a much-needed squirt of oil. The cap and oil can were presented by James Barnaby, well-known diesel engineer, and Mr. Corliss Nugent, head of the firm, obligingly brought the trademark to life, just as advertised.

(*Continued on Page* 34)

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people and plants . . Page 40
new literature . . . Page 44

ENGINEER'S FIELD REPORT

PRODUCT **RPM DELO OIL**

FIRM **Silva & Hill Construction Co.**
Los Angeles, Calif.

5,000 hours at 2,000 rpm before overhaul

Working at 2,000 rpm speeds in heavy dust, Silva & Hill Construction Co. operates 8 Caterpillar DW-21s (like one above) five days a week removing 3,500,000 cu. yds. of dirt and rock for Burbank golf course. Firm reports RPM DELO OIL keeps these units rolling an average of 5,000 hours before major overhaul. Says Maint. Supt. H. C. Basinger: "We've got 39 diesel-powered machines working to beat a one-year deadline. Any unexpected delay costs plenty. That's why we stick with 'DELO'. It's proved it will keep equipment rolling longer without engine breakdowns or repairs."

Lubricated with RPM DELO OIL, this Caterpillar D-8 Tractor (left) turned in 10,000 hours, bulldozing and pulling sheepsfoot rollers, before major overhaul. Frank W. Hill (right) Silva & Hill partner, reports: "We've used RPM DELO OIL in all our diesel units since 1940. It has really paid off in keeping our equipment in top running condition."

LUBRICATING OILS RPM DELO

TRADEMARKS "RPM DELO" AND CHEVRON DESIGN REG. U.S. PAT. OFF.

STANDARD OIL COMPANY OF CALIFORNIA, San Francisco 20
THE CALIFORNIA OIL COMPANY, Perth Amboy, New Jersey

Why RPM DELO Oils reduce wear—prolong engine life

- Oil stays on engine parts—hot or cold, running or idle
- Anti-oxidant resists lacquer formation
- Detergent keeps parts clean
- Special compounds prevent corrosion of bearing metals
- Inhibitor resists crankcase foaming.

For More Information or the name of your nearest distributor, write or call any of the companies below.

STANDARD OIL COMPANY OF TEXAS, El Paso
THE CALIFORNIA COMPANY, Denver 1, Colorado

industry news

(*Continued from Page* 32)

Union Pacific RR Builds New Diesel Shop

Union Pacific RR's historic roundhouse at Armstrong Yard at Kansas City, Kan., has been scrapped for a $2-million freight house and a diesel shop measuring 260 ft.

The diesel shop houses four tracks with elevated platforms and depressed pits to permit servicing 16 locomotives at three levels. A 260-ft outside servicing pit includes fueling and sanding facilities.

A.D.S. To Meet Again

The second membership meeting of 1958 for the Association of Diesel Specialists will be held at the Sherman Hotel in Chicago, on Sept. 18, 19, 20 and 21.

Highlights of the program will include: on Sept. 18, a tour of the Woodward Governor Co. at Rockford, Ill. including lectures, movie and lunch; on Sept. 19, a manufacturer-distributor conference and exhibit; on Sept. 20, technical talks on Nozzle Tip Reconditioning, Checking Cracks and Spray Patterns on Nozzle Tips, Inventory Control, and Products Liability, also a question-and-answer period with a Panel Forum of manufacturers of nozzle tips and holders; on Sept. 21, a closed business meeting of A.D.S. members and manufacturers.

Judging by this imposing program, those who attend will be in for a very interesting and enjoyable time while picking up some invaluable data and information.

SAE Farm, Construction and Industrial Machinery Meeting

Cracker barrel panels for informal discussion of practical engineering problems and techniques have been scheduled for the SAE national farm, construction and industrial machinery meeting at the Milwaukee Auditorium. The meeting plus an engineering display will be held there September 8 through 11.

Following is a list of some of the papers scheduled for presentation at the technical sessions: Turbocharged Diesel Eng. at Work; Future Army Engr. Const. Equip.; The Expanded Hgwy. Program; Engagement Characteristics of Wet Clutches; Dry Air Cleaners on Farm Tractors A Progress Report; Clean Air Cleaner Without Oil; Appl. & Performance of Dry Type Air Cleaners on Farm, Const. & Ind. Mach.; Now—Practical "Double Dry" Filtration with Donaclone; and Trends in Hydraulic Sys.

Correction

The Vibroswitch, a small vibration detector, is made by the Robertshaw-Fulton Controls Company's Aeronautical and Instrument Div. An item in the "Products At Work" section of Diesel Power, June, 1958, inadvertantly stated the manufacturers name as Robert Fulton Control Company.

A&D Diesel Service Only in Bklyn.

An item on the "industry news" feature page of Diesel Power, May, 1958, covered the open house reception held at A & D Diesel Service, Brooklyn. Jim D'Aversa, the owner, has advised that he is not associated with any shop in Hempstead, N. Y., as cited in the news item.

FUEL INJECTION EQUIPMENT DIVISION
of
LUCAS ELECTRICAL SERVICES, INC.
Head Office: 501 West 42nd St., New York
Sales Office: 14820 Detroit Avenue, Cleveland 7, Ohio
West Coast: 5025-29 W. Jefferson Blvd., Los Angeles 16, California
Branch Offices: 643 7th Street, San Francisco, California — 4937 West Belmont Ave., Chicago, Illinois
Canadian Distributors:
Joseph Lucas (Canada) Ltd., Head Office: 11 Davies Avenue, Toronto 8, Ontario
Branch Office: 3401 St. Antoine Street, Montreal 30, Quebec
AP174-820

LMOA Convention Coming Up

A fine technical and social program has been planned for the Locomotive Maintenance Officers' Associations Annual convention. This will be held at the Hotel Sherman in Chicago, Sept. 15, 16 and 17.

The following subjects are some of those to be highlighted during the technical sessions: Procedure for Storage of Diesel Locomotives; Extension of Diesel Locomotive Maintenance Intervals; Proper Storage Battery Maintenance; Equipment Necessary for Economical Battery Shop Operation; Equipment And Procedures for Diesel Parts Cleaning; Prevention of Grounds, Shorts and Opens; Lube Oil Coolers; Fairbanks-Morse O-P Maintenance, EMD 567-C Piston Rings; Reclamation of Diesel Locomotive Parts; Diesel Locomotive Water Treatment; Diesel Locomotive Standby Protection; Effect of Economy Fuel on Diesel Locomotive Maintenance.

MaK Rating Data

Our good friends, MaK, Machinenbau Kiel Aktiengesellschaft, Kiel-Friedrichsort, Germany, requested some important changes in their July advertisement but after the issue had gone to press.

To set the record straight, the MaK two-cycle, Model Z421 diesel engine is rated 500 to 1400 hp. Also, the MaK two-cycle, Type 8Zu 421 AK diesel engine with supercharging is rated 1400 hp at 375 rpm.

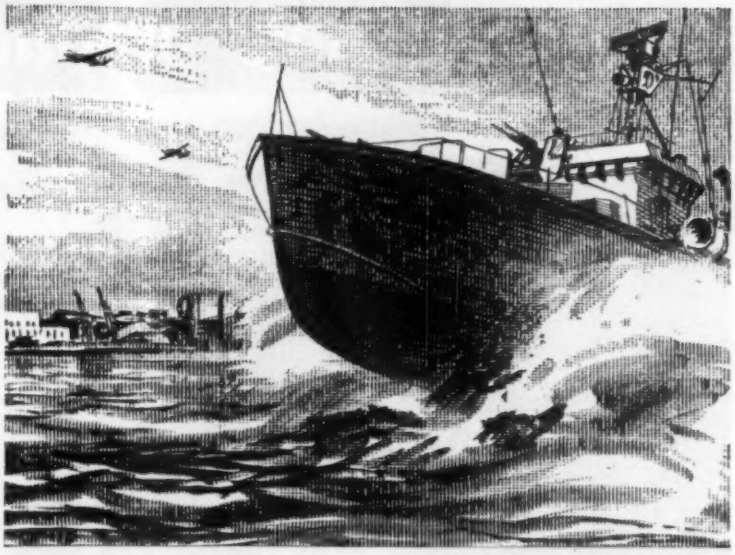
Incidentally, the MaK firm name and address are correct as given.

To Err Is Human

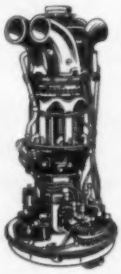
Looking at the cross sections of the Cerlist Model 3 diesel shown in Diesel Power last month, one might get the wrong impression as to the location of the combustion chamber and injector. The correct location of these elements is shown in a photograph of the cylinder head which was not supplied to us.

Our article states that Cerlist diesels have been tested in a number of services including irrigation pumping where the unit delivered 750 gpm at 1000 psi—oops it should read 100 psi.

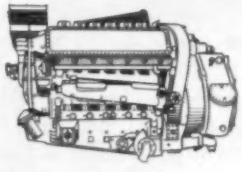
MORE POWER AT LOWER COST



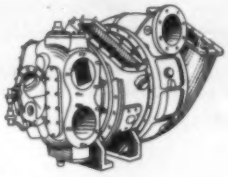
THIS IS NAPIER



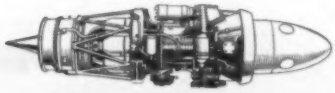
GAZELLE 1260/2000 s.h. p. Free Turbine:
designed for strenuous duty and long service between overhauls. Chosen for R.N. and R.A.F. helicopters. Allows new flexibility in helicopter design. Its simplicity means economical and speedy maintenance.



DELTIC 9 or 18 cylinder Diesel:
engine for merchant ships. Powers fast patrol boats and mine-sweepers of many Navies, police and passenger launches and the world's most powerful diesel electric locomotive. Deltic Diesel Engines are designed for power outputs from 825 to 3,100 h.p.

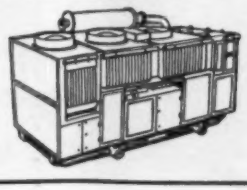


ELAND 3000/4000 e.h.p. Turbo Prop:
heralds a new era of economy for the airline operator and cheaper fares for the air traveller.
The Eland powers the Canadair 540 Airliner, the Fairey Rotodyne and the Westland Westminster Helicopter.



TURBO BLOWERS:
available in seven sizes for diesel engines afloat and ashore. Napier blowers give maximum power increase with low fuel consumption. Now in service in 8[illegible] countries.

DELTIC COMPAK
A compact source of power, easily transportable to normally inaccessible places, comprising Deltic Diesel engine plus generator, radiators, fuel tanks, pumps, etc. Road, rail and skid mounted sets at 1,200 kW and rail mounted sets at 2,640 kW. Weight 35,000 pounds. Envelope 24x8x11 ft



NAPIER ENGINES INC.

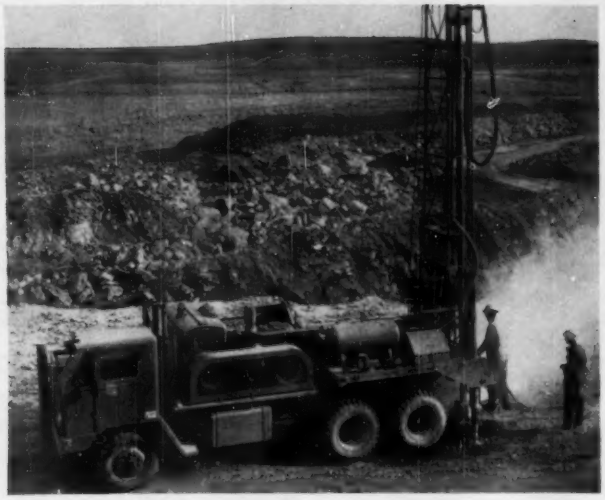
Suit 909, Dupont Circle Building,
1346 Connecticut Avenue N.W.,
Washington 6. D.C.
Telephone: North 7-9300

A subsidiary of D. NAPIER & SON LIMITED · LONDON · ENGLAND

Partners in Progress with
The ENGLISH ELECTRIC Company Ltd.

CRC S 24

new products



Rotary Drilling Rig

GM diesels power a new rotary drilling rig developed by the George E. Failing Co. of Enid, Okla., a subsidiary of Westinghouse Air Brake Co. The new rig is designed for use largely by mining, quarry, highway and construction industries. It is suitable for drilling blast holes, taking cores, soil sampling and other foundation work.

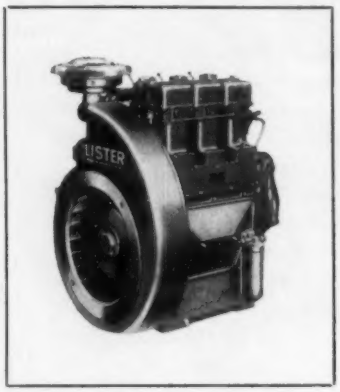
The unit is mounted on a GF-660 crane carrier truck. It is equipped with a 6-cyl Detroit Diesel engine driving a 100-S2 Le Roi air compressor. The truck engine, also a Detroit Diesel unit, furnishes power for the rotary table. The new rig can use both conventional-type rock or drag bits as well as new down-the-hole tools. Down-the-hole tools are recommended by the manufacturer for extremely hard formations.

Lister Adds HA Series Air-Cooled Diesels

Lister-Blackstone, Inc. of Long Island City, N. Y., will distribute in the U. S. a new series of air-cooled diesels made by R. A. Lister & Co. Ltd. These units are particularly suitable for driving pumps, generators, compressors, conveyors and hoists.

The 2-cyl, HA2 and 3-cyl, HA3 Models in this series develop 10 hp per cylinder at 1800 rpm. These 4-in. bore, by 4½-in. stroke units with a bmep of 78 psi, weigh 670 lb and 760 lb respectively. Fuel consumption of the smaller engine is 0.43 lb/hp/hr at full load, 1800 rpm. For the larger unit, it is 0.41 lb/hp/hr. At 1200 rpm, fuel consumption for the HA2 is reported to be 0.39 and for the HA3, 0.375 lb/hp/hr.

These units feature: a totally enclosed fuel injection system; hand starting from either end of the engine; full pressure lubrication; an impellar integral with the flywheel that provides efficient cooling and eliminates problems connected with belt-driven fans; and interchangeability of all working parts.



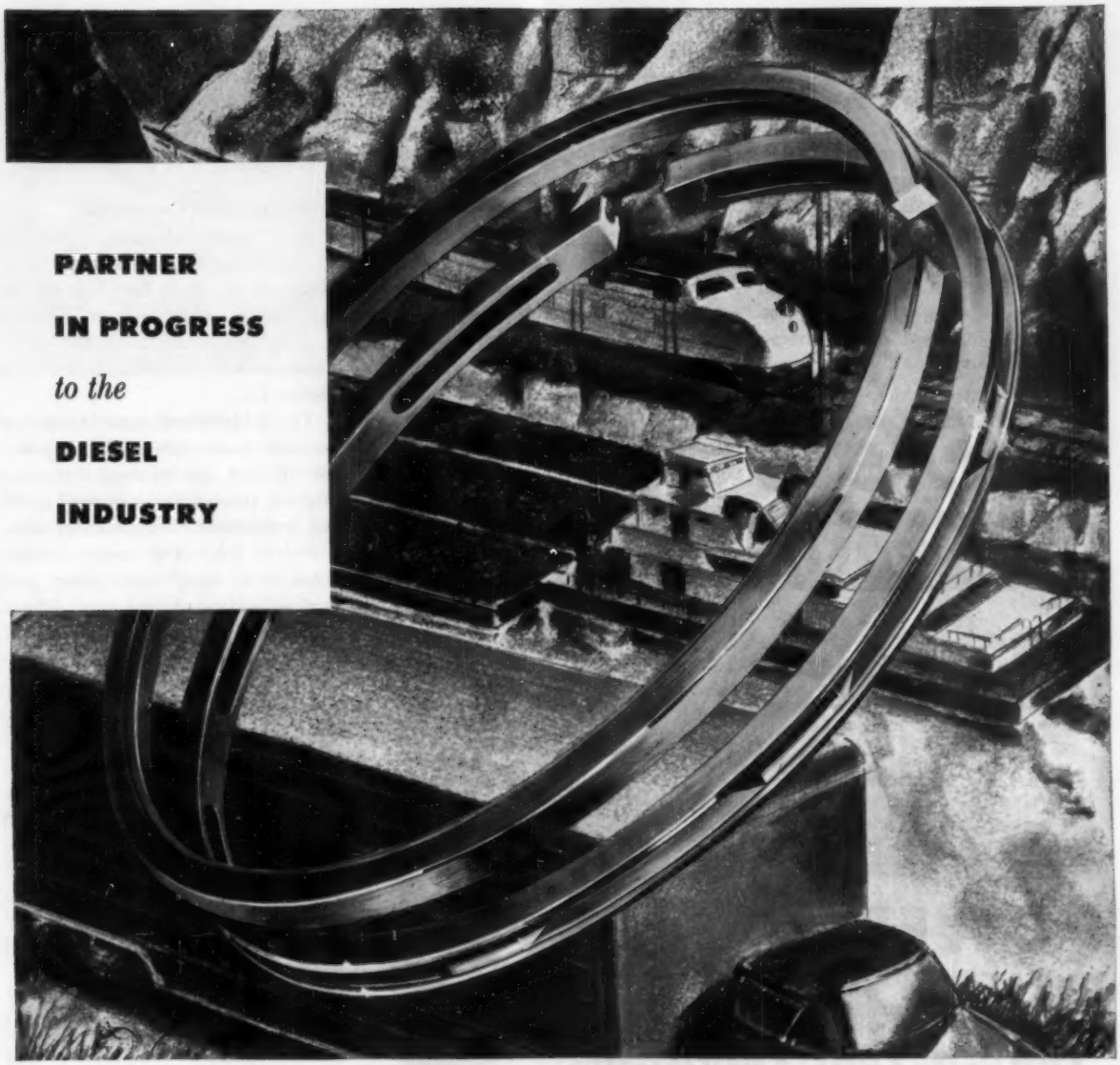
Mobile Steam and Hydraulic Jet Cleaner

For fast, thorough cleaning of construction equipment, tractors, engines and other machinery requiring heavy-duty cleaning at the job site, a new unit is available.

Clayton Mfg. Company's LP gas-fired CS-628 is a combination steam and hydraulic jet cleaner on a Volkswagon truck. This mobile, self-contained unit supplies a hydraulic jet stream or steam

The unit expands the line of Clayton steam cleaners. These cleaners have been in widespread use for several years in the automotive, marine, engine building and other industries.

(*Continued on Page* 38)



Leading diesel manufacturers turn to Perfect Circle—with confidence!

No other rings are backed by such rich resources in research and engineering. And no other ring manufacturer matches the Perfect Circle record in ring designs for all types of applications...automobiles, trucks, tractors, marine and aircraft...including rings for diesel duty designed in close co-operation with diesel manufacturers.

No wonder so many big names in diesels use Perfect Circles as original equipment... and for replacement service too. That's a fact worth keeping in mind whenever you specify piston rings. And if you're faced with any problem concerning rings, remember that you are welcome to consult with our engineering staff at any time. Perfect Circle Corporation, Hagerstown, Indiana; The Perfect Circle Co., Ltd., Don Mills, Ontario, Canada.

PERFECT CIRCLE PISTON RINGS

new products

(Continued from Page 36)

Motor Base Maintains Proper Belt Tension

Automatic Motor Base Co., has announced two new models of motor bases for maintaining the proper amount of tension in belts. Sizes range from ¼ to 500 hp. It is claimed that these bases reduce maintenance and down-time, increase the life of belts and bearings, and sustain maximum machine output.

Extractors Removed Easily When Broken

The Roddick Tool Co. has developed a screw extractor which is said to permit easy removal if it breaks. The new Wedge-Pruf screw extractors are composed of two parts. The outer hexagon jacket is spline-fitted to the heat-treated high-alloy extractor, and shaped to allow maximum torque. If the extractor should break, a substantial portion projects above the Wedge-Pruf shoulder permitting easy removal.

ROCKFORD

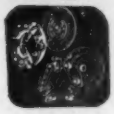
OIL FIELD TYPE

LONG LIFE
Heavy-Duty

POWER TAKE-OFF

Once-a-Year Lubrication

Eliminates the Pilot Bearing
Release and Main Bearings are lubricated for one year
Main Bearings are 40,000 hour type
Handles 5,000 pound Belt Loads
Out-Board Bearings and Flexible Couplings eliminated
Furnished with Single or Double Plate, Organic or Morlife faced Gear tooth Type Clutches


Small Spring Loaded

Heavy Duty Spring Loaded

Oil or Dry Multiple Disc

Heavy Duty Over Center

Power Take-Offs

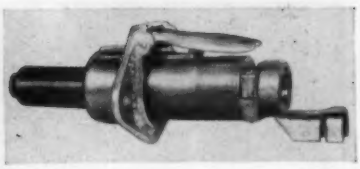
Speed Reducers

Insure longer work life and reduce down-time with this NEW extra heavy-duty ROCKFORD POWER TAKE-OFF.

SEND FOR THIS HANDY BULLETIN
Gives dimensions, capacity tables and complete specifications. Suggests typical applications.

ROCKFORD Clutch Division BORG-WARNER
1301 Eighteenth Ave., Rockford, Ill., U.S.A.
Export Sales Borg-Warner International — 36 So. Wabash, Chicago 3, Ill.

CLUTCHES



Battery Cable Connectors

A "battery-capacity" electrical "power take-off" connector capable of transmitting heavy-duty current to start and power all types of industrial engines and other motorized equipment is now in production by the Cole-Hersee Co.

The #11040 connector is suited to transmit heavy-duty electrical power for efficient operation of stationary engines, construction and road building equipment, refrigerating units, industrial truck and tractor installations, farm equipment, power generating equipment, and many others.

The Cole-Hersee "battery load" connectors are designed to accommodate 0, 1 or 2 gauge cable.

Garrett Develops Small Gas Turbine Power Package

An extremely small gas turbine power package has been developed by The Garrett Corporation's AiResearch Mfg. Div. in Phoenix, Arizona. The new engine, comparable in size to a typewriter, puts out 30 hp. It is 16-in. high, 13-in. wide and weighs 45-lb.

The tiny turbine, model GTP 30, can serve as a power drive for generators, pumps, compressors and blowers. It is readily adaptable for use on any type of vehicle, boat, aircraft or ground installation.

Self-Tapping Insert Speeds Installation

"Speed-Sert", the new self-tapping insert by Newton Insert Co., eliminates a separate tapping operation. They are designed for low-cost speedy installation into aluminum and magnesium alloys and plastics to provide a steel thread in these softer-than-steel materials. They protect against stripped threads and are suitable for salvage and repair of stripped threads.

Speed-Serts are available in cadmium-plated carbon steel, stainless steel or brass.

Compact Heat Exchanger

A line of small rotary, air-to-air heat exchangers which can handle waste gases at 1000°F from gas turbines and free piston machinery has been developed by The Air Preheater Corp. It is about 20-in. in diameter and 11-in. in overall depth. This heat exchanger designed principally for regenerative cycles can handle flows of 250 cfm. Larger units up to 4-ft in diameter can handle 2600 cfm. Efficiencies of 90% or more are reported.

Tester Checks Monoxide Level

A dual-purpose carbon monoxide tester made by Oxy-Catalyst, Inc., is now available for detecting carbon monoxide in the engine exhaust stream and in room air. This direct-reading unit called the Oxy-Monoxo, will detect CO in the range of 100 to 1000 parts per million.

A detector kit consists of a push-button-operated aspirator pump with a connector for holding the detector tube; 24 replaceable sealed glass detector tubes with chemical-gas detector chemical; and six rubber caps for the tubes.

Nugent Offers High Pressure Filter

Wm. W. Nugent & Co., has made available a new series of laminated-fiber disc filters, the 1555CP. They are designed for hydraulic and other high pressure applications up to 3000 psi.

The five available sizes have capacities ranging from 1.5 gpm at 3 psi pressure-drop to 47.6 gpm at 6 psi pressure-drop when filtering 100 SSU viscosity mineral oil.

Diesel Starting Fluid

"Quick-Start", a compounded ether-base petroleum product made by the Turner Brass Works, Sycamore, Ill., is specifically made to trigger ignition in a diesel. It also sustains initial combustion of regular fuel.

It is particularly suited for diesel-powered trucks, busses, tractors, road building equipment, boats, mining equipment, etc.

Starter fuel is stored in a tank under pressure which discharges vapor through a copper tube into the intake manifold. To operate "Quick-Start", a choke is pulled out for about 2 seconds, then the engine starting button is pushed.

The starter fuel comes in a disposable tank that can be unscrewed from the unit and replaced in seconds. Each tank gives about 250 starts. Installation is simple and takes but a minute or two.

(*Continued on Page* 43)

GIVE YOUR ENGINE

A FIRST CLASS TICKET

TO

FROM

WITH

LINERS

CHANNELCROMED

Proven most durable in eleven years of field use. LOWEST RATE of lubricating oil consumption. Chosen after 3½ year wear tests for the HEAVIEST DUTY ENGINES firing at 2,200 pounds pressure, Diesel cycle.

PENNINGTON CHANNELCROMIUM COMPANY

319 Dakota Street
San Antonio 3, Texas

Write for Bulletin 82

people and plants

Con Diesel Names General Mgr. for Test Equipment Div.

Consolidated Diesel Electric Corp. has appointed John A. Grimes as general manager, of the Test Equipment Div. Mr. Grimes' has been with Con Diesel for three years. He has been administrative engineer and assistant to the president. Prior to joining the company, he was a civilian employee of the U. S. Air Force for 17 years.

Detroit Controls Names Product Managers

A product planning manager has been assigned to each product class at Detroit Controls Div. of American-Standard. He will be responsible for planning, development and marketing of new products.

H. L. Walker, formerly sales manager of appliance sales, becomes product planning mgr. of Industrial Controls. His responsibility also includes Vernathem Product Planning.

Nordberg Appointment

Emmons L. Farrell has been appointed district manager of the Minneapolis Territory of the Engine Division of Nordberg Mfg. Co. He will headquarter in the Division's new District Office, Suite 533, Metropolitan Building, Minneapolis.

Formerly he was district manager of the Milwaukee Territory. He joined Nordberg in 1943 and was named a sales engineer in 1949.

Orenda Forms New Company

Orenda Engines Ltd., a subsidiary of A. V. Roe Canada Ltd., has formed a new company called Orenda Industrial Inc. Sales and service of Brush electrical equipment and Petter, McLaren, National and Mirrlees diesel engines formerly distributed by Brush Aboe, Inc. will now be handled by the new company.

Orenda Industries Inc. will have its head office in New York and a branch office in San Francisco.

Briggs Appoints Director Of Research & Development

C. H. May has been appointed director of research and development of The Briggs Filtration Co., Washington, D. C. He joined the company in June 1957.

He was formerly project engineer at U. S. Engineer Corps, Fort Belvoir, Va., and filtration engineer for the Pigments Div. of E. I. DuPont De Nemours & Co.

Admiral Named To DeLaval Post

Rear Admiral Mitchell D. Matthews USN (Ret.) has been appointed manager of the Service and Repair Div. of DeLaval Steam Turbine Co. Trenton, N. J. He retired from the U. S. Navy in 1957 after 30 years of service to join the DeLaval organization. His last Naval post was that of supervising inspector of Naval Material, N. Y. which he held since 1954.

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It symbolizes Know-How, Modern Facilities and Ethics in Sales and Service of FUEL INJECTION EQUIPMENT, GOVERNORS and ALLIED EQUIPMENT. It guarantees—Work performed by FACTORY-TRAINED TECHNICIANS using FACTORY-APPROVED METHODS.

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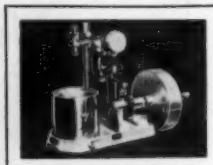
THE BEST IN WORKMANSHIP AND MATERIALS

Plan to attend the A. D. S. CONFERENCE and MANUFACTURERS EXHIBIT—HOTEL SHERMAN, Chicago, SEPT. 18-19-20-21.

ASSOCIATION of DIESEL SPECIALISTS, INC.
For information contact: S. E. Franklin, Secretary
P.O. Box 1116, Wilmington, Calif.



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Compact bench model for precision testing any type injector nozzle. Complete utility at low cost.

The perfect trio...

. . . for the Diesel repair shop. Provides the necessary equipment for running essential tests on injection units and for re-conditioning injector nozzles.

Write for details today on utilizing this perfect trio for outfitting the smaller service shop at moderate initial cost—or on adapting the units to speed service techniques in any repair shop.

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Insures perfectly concentric nozzle bodies and needles with a fine finish. Its immense scope, speed and ease of operation cut nozzle servicing costs.

Over 25 years of continuous research and production behind every Hartridge machine.

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For testing and calibrating all types of fuel pumps . . . provides utmost accuracy . . . rapid and easy to operate . . . combines rugged modern design.

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Sales & Service, Inc.
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J. J. Ford

F. Maier

Appointments At Hartford Machine Screw Co.

J. A. Taylor, president of Hartford Machine Screw Co., Division of Standard Screw Co., has announced the appointment of J. J. Ford as general manager and F. Maier as sales manager of the Fuel Injection Div.

Mr. Ford joined the Company in 1946 and has been sales manager of the Fuel Injection Div. for the Roosa-Master injection pump, their new fuel filter and allied products for the diesel industry. He is a member of the SAE.

Mr. Maier joined the Company in April 1958. He had been with the American Bosch, Div. of American Bosch Arma Corp. since 1934.

Other appointments in the Fuel Injection Div. included F. R. Hill as assistant sales manager, J. N. Britton as service manager and P. Demase as assistant factory manager in charge of the division's product production.

Very shortly, construction will be started to provide for further increases in business, and furnish more ideal plant operating conditions for assembly and testing of products.

Mack Trucks To Build Headquarters In Toronto

Mack Trucks, Inc., has started construction of a million dollar sales-service center in Toronto. This is part of Mack's long-range expansion program in Canada.

The structure will be the main sales and service headquarters for the greater Toronto area. It will also house the executive offices of Mack's Canadian subsidiary, Mack Trucks of Canada, Ltd. It is scheduled for completion next January.

Mack is reported to be supplying over half of all diesel vehicles sold in the Canadian market.

(*Continued on Page* 42)

STOP
ENGINE DAMAGE

with these low-cost Fulton Sylphon
FAIL-SAFE
SAFETY CONTROLS

No. I-530 Series
Remote Bulb Type
FUEL SHUT-OFF
Safety Control

Positive engine protection against high temperature jacket water and low pressure lube oil. Fuel oil supply is immediately shut off if either exceeds safe limits. Automatic shut-off if control is damaged accidentally. Alarm optional.

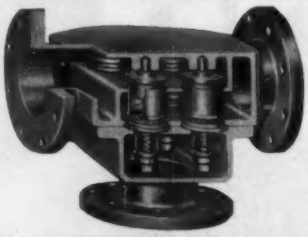
No. I-539 Series
Integral Bulb Type
4-WAY SAFETY
Temperature Pressure Switch

Sounds alarm, flashes warning light, operates pilot or stops internal combustion engines if lube oil pressure drops to danger point, or if cooling water temperature is too high. Suited for many other temperature-pressure applications.

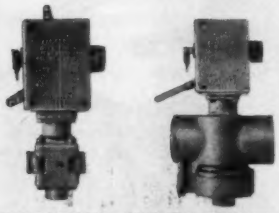
WRITE FOR CATALOG PD-817

Robertshaw-Fulton
CONTROLS COMPANY
FULTON SYLPHON DIVISION
Knoxville 1, Tenn.

AMOT ENGINE CONTROLS

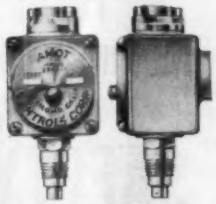


THERMOSTATIC VALVES, for jacket water and lube oil temperature control. Self contained, modulating, use no external bulbs. Sizes 1½" to 6". Temperature settings 75°F to 195°F.



MECHANICAL SAFETY CONTROL VALVES, used to shut down engines and compressors in event of oil pressure failure, overspeed, overheating of jacket water or lube oil, etc.

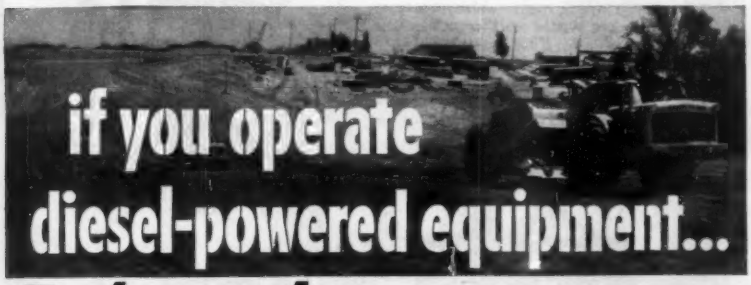
VENTED GAS VALVE, diaphragm operated will shut off the fuel gas and vent the manifold when used on internal combustion engine applications. Made in 2", 3" and 4" sizes.



SAFETY CONTROL SWITCH will flash warning signal, sound an alarm or close a solenoid fuel valve on overheating of jacket water or lube oil, or pressure failure of lubricating system.

AMOT CONTROLS CORPORATION

FIRST STREET & NEVIN AVENUE • RICHMOND, CALIFORNIA



Tachographs help cut down "lugging"

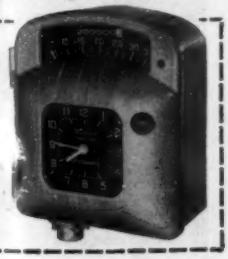
...lengthen engine life...save fuel!

The RPM Tachograph is a recording tachometer which gives your operators a constant guide for proper engine operation, flashes a warning light when predetermined control speed is exceeded, and provides supervisors with an accurate charted record to check operator performance. In addition to engine speed in RPM, the Tachograph chart records time, total engine revolutions, and OFF periods.

A small investment in an RPM Tachograph for every diesel engine you operate can pay big dividends by reducing costly "lugging."

Tachographs are easy to mount and position on the instrument panel, are ruggedly built and tamper-proof. Bulletin SU-107 tells the whole story—mail the coupon today.

Wagner Electric Corporation
6423 PLYMOUTH AVENUE, ST. LOUIS 14, MO., U.S.A.



Name and Position_____
Company_____
Address_____
City_____ State_____
We operate_____ (NUMBER) Vehicles

people and plants

(*Continued from Page* 41)

Promotion At Tobin-Arp

Walter J. Scowcroft has recently been promoted to vice president in charge of sales in the Automotive Div. of the Tobin-Arp Mfg. Co.

Mr. Scowcroft, began his affiliation with the company in 1954. For the past four years, he has served as district manager in the Ohio Territory.

Admiral Joins Garrett Corp.

The appointment of Admiral Selden B. Spangler, U.S.N. (Ret.), as director of research for The Garrett Corp. has been announced.

Widely recognized as the father of the Navy's gas turbine program (1939-1946), Admiral Spangler is usually given a large share of credit for overall development of the propeller gas turbine in the United States. He is directly credited with development of the turbo-compound engine.

Executive V-P Elected At Stratoflex

Election of J. Tullis as executive vice president of Stratoflex, Inc., Ft. Worth, Texas, has been announced by president Ken Davis.

Formerly executive vice president of Unit Rig & Equipment Co. in Tulsa, Tullis has also been acting as vice president—manufacturing of Stratoflex, Inc.

In Memorium

E. R. Bonnist, 62-year old advertising director for The Cooper-Bessemer Corp. for over 35 years, has died. Death was due to a heart attack.

In his position at C-B, he directed the company's program of advertising, sales promotion and public relations. As a result of this work, he became well known throughout the industries served by C-B engines and compressors.

Mr. Bonnist was a member of the Assoc. of National Advertisers and was connected with the National Industrial Advertisers Assoc.

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AIR STARTING MOTORS!

Dependable: Fast, positive starts regardless of temperature. Made by the originators of Air Starting Motors.

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Three sizes: I-R Air Starting Motors are made in models to meet the needs of almost all stationary, auxiliary and motive engines.

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18-769

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MODEL K-120

universal peak firing and compression pressure indicator

Adaptors for most models U.S.A. engines. Others made to order at reasonable prices.

The Model K-120 is the only maximum pressure indicator that can be used as a compression tester on small, high-speed engines and as a firing pressure indicator on engines having indicator valves. Patented Kiene diaphragm type check valve of stainless steel has no springs or piston, no complicated adjustments, temperature corrections or pressure loss. Bleeder valve permits release of indicator pressure for repeat readings. This instrument gives true pressure readings with an uncompensated gage.

KIENE DIESEL ACCESSORIES, INC.
10352 PACIFIC AVE., FRANKLIN PARK, ILLINOIS

new products

(*Continued from Page 39*)

ElectroTach For Automotive Engines

Dixson Products Co., makers of ElectroTach electric tachometers, now has new models especially designed for bus and truck engines, and low-speed engines in the marine and industrial fields. They are scaled 0 to 4,000 rpm to secure maximum accuracy and a wide needle sweep in the engine working range.

The new models are compact, self-contained units requiring no sender or cable connector. They are reported to give the high degree of accuracy. Installation is simple.

Hand-Operated Impact Wrenches

The Swench Model 1000, latest addition to a line of hand-operated impact wrenches made by Swenson Engineering of Branford, Conn., is said to deliver torque values up to 15 times that applied by the operator to the handle. It makes it possible for one man to tighten or loosen 1¾-in. bolts.

The Swench eliminates the need for a power supply on high torque jobs. It achieves its torque magnification by means of a rotary hammer actuated by a coil spring contained within the tubular handle. As the hammer is pulled, a spring and rotor mechanism automatically delivers rotary hammer blows or impacts through the socket to the fastening.

Eaton Mfg. Co. Plans To Acquire Fuller Mfg. Co.

Eaton Mfg. Co., Cleveland, O., maker of power-driven rear axles for medium and heavy-duty trucks and off-the-road equipment, proposes to acquire the Fuller Mfg. Co., of Kalamazoo, Mich., builders of transmissions, in exchange for stock. This is subject to approval of shareholders of both companies.

Upon completing the transaction, Fuller would be operated as a wholly-owned subsidiary of Eaton. No changes are contemplated in its present management, personnel, products and sales policies.

COOPER-BESSEMER
MODEL GSB
CYLINDER HEADS
WITH VALVES
Part No. CB0420C
NEW! NEVER USED!
Very Attractive Price
Box RS-8581, c/o Diesel Power

Affording Maintenance At Less Cost
. . . Specializing in REPLACEMENT Parts for CUMMINS ENGINES . . .

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- Water Pump Parts
- Rocker Housing Assemblies
- Rocker Parts
- Push Rods
- Cam Follower Parts
- Hose Assemblies

Pacific DIESEL Parts Co.
4650 E. Florence Ave., Bell, Calif.
LUdlow 1-6082

new literature

1958 Directory of Highway Officials and Engineers

For those interested in contacting highway departments, officials and engineers, a 1958 directory entitled "Highway Officials and Engineers" is available. It is published by the American Road Builders Association. As in previous years, the directory costs $1.00 per copy.

Supplement Covers Helical Gear Drives

Folder 2651-A, a 6-page supplement to Link-Belt Book 2651, contains complete data on horsepower ratings, dimensions, mounting information and a resume of construction principles applying to the new quadruple-reduction speed reducers.

It also contains data on double-reduction, and triple-reduction helical gear drives.

Nordberg 4-Cycle, Vee-Engines

The complete line of Nordberg 4-cycle vee-type engines is described in a new 2-color, 18 page bulletin released by the Nordberg Mfg. Co. Examples are shown of significant advancements in diesel engine performance for vee-type engines that are supercharged, supercharged and intercooled and Supairthermal.

Long-Life Calcium Battery Data

Industrial battery users will get a big assist from a new bulletin in selecting calcium storage batteries for switch gear, alarm system, telephone control, signalling, emergency lighting and other services where batteries are used for standby power. This 12-page reference and specification Bulletin #GB1848 is now available from the Industrial Div. of Gould-National Batteries, Inc.

It discusses uses, calculating and installation procedures and development of the calcium stationary battery and gives engineering specifications.

Torque Converter Fluid Data

What should you look for in a heavy-duty fluid for torque converters, automatic transmissions, rotary air compressors and hydraulic systems? A folder providing complete information on D-A torque fluid has been published by D-A Lubricant Co., Inc.

It describes selection and use of this fluid in the above applications and gives its advantages.

Off-Highway Tire Service Shortcuts

A catalog by Schrader's Son, Division of Scovill Mfg. Co., Inc. gives many shortcuts on off-highway tires. It is packed with data and specifications on full lines of all the latest, most practical valves, tools and fittings. New gauging and inflating equipment are also covered. Send for your copy today. Use the Reader Service Card.

(*Continued on Page* 47)

FREE to Every Shop Operator

- Diesel Compression Testers
- Nozzle Testers for American Bosch, Caterpillar and Bendix Nozzles
- Cummins Injector Tester
- International Harvester Injection Testers
- General Motors Injector Testers
- Injection Pump Calibrating Stands
- Nozzle-Injector Cleaning Tools and Lapping Blocks
- Engine Overhaul Stands
- Engine Removal and Parts Dollies
- GM 71 Engine Tools

76 Pages—275 Illustrations
56 Engine Reference Tables
26 Parts Lists

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clean **FASTER, BETTER . . . *at* LOWER COST!**

Lix cleaners are so effective that diesel cleaning time is shortened to a very minimum—cut costs 'way down. Lix **soaks** away all grease, grime, grit and caked carbon—no brushing or scraping is necessary. Lix cleaners are **harmless** to all metals during cleaning cycle.

Lix Cleaners are **safer**—are of low toxicity, are not a fire hazard. Longer life without frequent charges, too.

There's a Lix Diesel Cleaner for any diesel cleaning job: **Spray** type, **Tank** type, **Electric Equipment** cleaners . . . **Non-Chlorinated** or **chlorinated.**

Write, wire or phone for literature to cover your particular needs.

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Amazing new LIX CARBURETOR CLEANER cleans carburetors FAST, SAFELY! Parts come out looking like new!

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INJECTOR CUPS and TIPS
STANDARD AND 21° FOR THE LEADING TRUCK DIESELS
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Volume production on automatic machines means SAVINGS
We pass this on to the consumer
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BELL DIESEL RESEARCH
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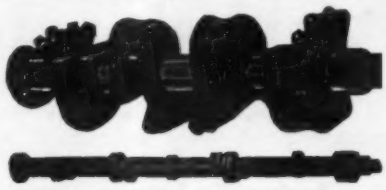

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THERMOMETERS

These instruments are a series of marine type thermometers designed for all diesels and all plant uses—water or oil.
FEATURES All brass construction, nickel finish, cork insulation.
(Repair service available)
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Price
$6.65 ea $5.70 ea
35 years continuously in the diesel engine business.
Write for catalog.
DIESEL PLANT SPECIALTIES CO
Stevens Point, Wisconsin

new literature

(*Continued from Page 44*)

GM Injector Comparator And Injection Tester Described

A selected set of injectors with identical output will increase engine output and efficiency, cut fuel consumption and generally improve overall operating conditions.

Matched G.M. injector sets (injectors with the same output) may be obtained by using the J7041 comparator made by the Kent-Moore Organization, Inc. How this instrument works, as well as how it is set and used in conjunction with injectors from Series 71 and 110 Detroit Diesels, is covered in Kent-Moore's bulletin Form No. 58-25.

Another bulletin, Form 58-53 covers the injection testers used with Series 71 and 110 engines. The bulletin tells how these instruments are used to test spray pattern, valve opening (pop) pressure; holding pressure, and high pressure according to Detroit Diesel's revised specifications.

RoadRanger Transmission Data

A 10-page Form No. 114 by the Fuller Mfg. Co., covers stick, semi-automatic Fuller RoadRanger transmissions. It provides data on the R-35, R-46, R-63, R-630-D, R-96 and R-960 RoadRangers for over-the-highway operation and the R-1150 and new R-1550 RoadRangers for off-highway service.

Included are complete shifting patterns, gear ratios and the percent of step between ratios for all standard and optional ratios. Condensed specifications for weight, size, approximate engine size, mounting, clutch housings and oil capacity are shown for each model.

Catalog and Kit Describe Fram Industrial Filters

An illustrated, 2-color master catalog and sales kit, by the Fram Corp. covers their new line of industrial filter equipment.

The "Industrial Sales Kit" contains a master industrial catalog, "Cross Flow Filcron" and "Filcron" (by-pass) samples and an envelope stuffer.

The master industrial catalog includes: a 20-page industrial catalog; a 16-page general products catalog; a 36-page air filter catalog; and a 76-page filter specifications catalog.

These catalogs include illustrations, diagrams, dimensions, pressure-flow specifications, curves, descriptions, etc., of filters for diesel, gas, dual-fuel and marine engines, plus all industrial applications.

(*Continued on Page 48*)

we do 1 thing - and we do it very well!
America's largest GM fuel injector rebuilder
Interstate
diesel service incorporated
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Regrinding • Straightening • Thermit Welding • Metallizing • Crankpins Turned Off in Place

115 CLIFTON PLACE BROOKLYN 38, NEW YORK MAIN 2-5242

new literature

(*Continued from Page 47*)

Conversion of Hand-Valves To Motor-Valves

A 4-page, 2-color catalog published by the C. H. Wheeler Mfg. Co., describing a new automatic valve actuating conversion unit is now available. The new unit, known as Valvmatic, converts hand-operated valves to motor operation.

The catalog explains the six steps in the installation of the unit and illustrates each with photographs. Design, metallurgy, and maximum pressure differential data is included.

80-Page Expansion Joint Catalog Available

Badger Mfg. Co. of Cambridge, Mass., has made available an 80-page catalog covering their S-R expansion joints. This catalog contains a great deal of data for anyone doing any type of piping.

It includes: data for rating expansion joints subjected to axial or lateral movement, angular rotation or combinations of these movements; formulae and tables for calculating forces and/or bending movements developed in connected piping; tables of dimensions and weights for expansion joints from 3-in to 72-in in diameter; and other engineering data.

Brochure On Instrumentation And Controls

The Bridgeport Thermostat Div. of Robertshaw-Fulton Controls Co., has issued a 2-color brochure describing "Formweld". This is a metallic welded bellows having broad applications in the instrumentation, automation and industrial fields.

Catalog Covers E-M Packaged Generators

Publication No. 227, issued by the Electric Machinery Mfg. Co. illustrates and describes E-M packaged generators. These units range from 3.75 to 187 kva, single and three-phase, 50 or 60-cycle in voltages up to 600. Both physical and operational advantages of the generators are covered.

Tuthill Pump Line

A 12-page catalog, No. 100, published by the Tuthill Pump Co. contains basic information on the company's complete line of pumps, fluid motors and valves.

Included are descriptions of the operating principles and internal constructions of Tuthill's various types of pumps. Also included is a complete pump guide selection chart that classifies all models as to operating requirements, construction features, mountings, packing characteristics and the services for which applied.

Refilco 1958 Oil Filter Catalog

Refill Filter Co. of Newark. N. J. has just issued their latest 1958 catalog (#BTA-58). It covers the complete line of Refilco "Premium-Pack" oil filter replacement cartridges which are unconditionally guaranteed for 5000 miles or its hourly equivalent.

The line covers filter cartridges for diesels in the automotive field. Lube and fuel oil filter cartridges for diesels in the construction, farm, marine and industrial fields are covered in a supplementary catalog #CFM-58.

Robertshaw Vibraswitch Explained

The Model 65 Vibraswitch is said to provide protection for large motors, pumps, compressors and other rotating equipment by responding to mechanical malfunctions the instant they occur. It may be wired to actuate an alarm or cause a shutdown before costly damage occurs.

For those in need of this protection, a bulletin released by the Aeronautical and Instrument Div. of Robertshaw-Fulton Controls Co., illustrates and describes the functions of Model 65 Vibraswitch malfunction detector. Operating principles, installation diagrams, dimensions and adjustments are covered in the 4-page, 2-color bulletin RF-586.

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WITH FULL FLOW AND BY-PASS FILTERS FOR ENGINE LUBE AND FUEL OIL

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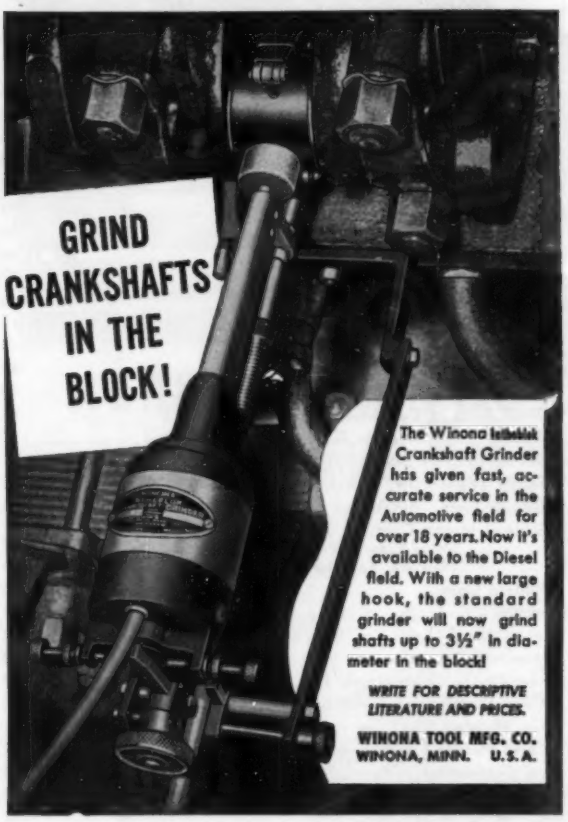

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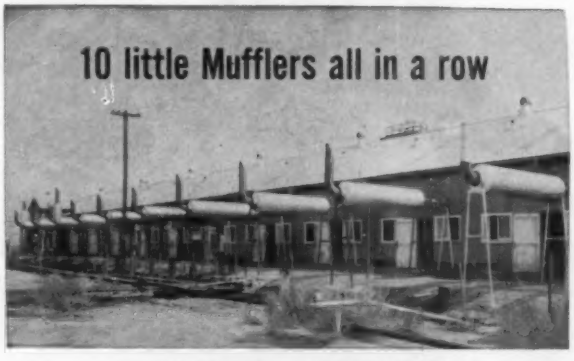

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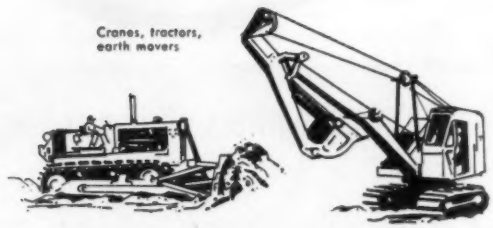

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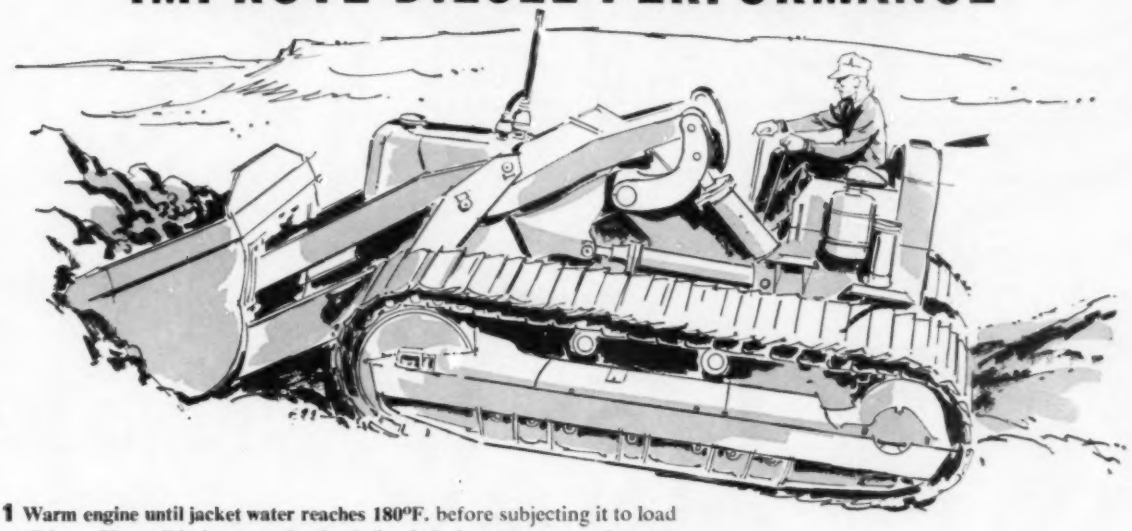

1 **Warm engine until jacket water reaches 180°F.** before subjecting it to load conditions. If possible keep mechanized diesels in heated garage when not in use.

2 **Protect crankcase pans of mobile units** with shutters or similar devices that will insulate against icy winter blasts.

3 **Be sure fuel injection system is working properly.** If the fuel injection system permits raw fuel to reach the cylinder walls, it will impair operation by diluting with the oil and helping soot to reach the crankcase.

4 **Avoid sooty fuel.** Remember that a diesel engine normally produces five to eight times more soot than a gasolene engine. A dirty fuel—a fuel that produces black exhaust, will greatly increase this amount of soot.

5 **Choose your lubricating oil carefully.** Diesel engines produce more combustion impurities than gasolene engines. Consequently, it is imperative to use oil made from high-quality base stocks, with a sufficiently high additive level to protect engine parts. **For most high-speed mechanized diesels, Cities Service C-300 Motor Oil perfectly fills these requirements.** Cities Service C-300 is made from the finest base oils, strongly fortified against oxidation and corrosion. Its excellent detergent-dispersant qualities help keep insolubles in suspension, prevent engine damage. Many diesel operators credit Cities Service C-300 for doubling and tripling periods between overhaul.

6 **When in doubt, consult a Cities Service Lubrication Engineer.** Years of specializing in lubrication problems and recommendations enable your Cities Service Lubrication Engineer to give worthwhile advice and assistance for your operation. One of these men will gladly survey your lubrication needs at no cost or obligation. Contact your nearest Cities Service office or write: Cities Service Oil Company, Sixty Wall Tower, New York 5, N. Y.

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